# ABSTRACTS

## of recent published material on

## Soil and Water Conservation

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UNITED STATES DEPARTMENT OF AGRICULTURE

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Authors of articles and reports in the field of soil and water conservation are urged to supply abstracts, reprints, or copies to the abstractor:

Charles B. Crook, Soil and Water Conservation Research Division,
Agricultural Research Service, U.S. Department of Agriculture,
Plant Industry Station, Beltsville, Md. 20705

# CONTENTS

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*Use Pesticides Safely*

**FOLLOW THE LABEL**

U.S. DEPARTMENT OF AGRICULTURE

# WATERSHED ENGINEERING

## Watershed Development

See Also 4, 7-11, 14, 16, 17, 67, 103.


1.   Cook, N. R. EFFECTS OF UPSTREAM FLOOD PROTECTION ON LAND USE WITH
     SPECIAL REFERENCE TO THE UPPER WASHITA RIVER BASIN OF OKLAHOMA.
     Okla. Agr. Expt. Sta. Proc. Ser. P-501, 28 pp. 1965.


Protecting bottomland against damaging floods often makes it possible to reorganize a
farm and increase profits, but actual changes usually are fewer than those considered
potentially profitable. Three comparable pairs of protected and unprotected watersheds
were examined to determine if there were actual differences in intensity of land use. In
two of the pairs there were obvious differences in intensity of bottomland use, but in one
pair few differences could be detected. Apparently a number of farmers have shifted cotton
from upland to bottomland after protection.
   Relatively large increases in alfalfa were predicted by the watershed planning parties
in all the watersheds except Beaver Creek. Though the trends in bottomland devoted to
alfalfa were not shown, there have been few increases in any of the watersheds.
   Linear programming, can be used to predict likely changes in land use that will occur
if information about farmers' behavior and goals is known. Linear programming solutions
corresponded to actual farm situations best when reservation prices on nonland capital
were assumed to be from 17 to 24 percent.
   The programming analysis indicated profitable shifts in land use consistent with as-
sumed flood damage reduction factors. The major shifts were cotton and wheat from up-
land to bottomland accompanied by increases in temporary pasture, some small grains,
and sorghum on the upland.
   In watersheds where bottomland is used intensively in spite of flooding, or where good
upland is available, shifts in allotted crops may not occur.
   Benefits from changes in land use may be negligible in some watersheds because of
the corresponding shifts in upland use. The corresponding shifts are difficult to predict
unless a "whole farm approach" is taken.


Okla. State U. Agr. Expt. Sta., Stillwater, Okla. 74075


2.   Cross, J. M. SMALL WATERSHEDS BIG BUSINESS IN LOUISIANA. Land and Water
     Contract. 7(11): 8-9. 1956.


A report was given on overall demand for small watershed projects in Louisiana.

SCS, USDA, Alexandria, La. 71301

3.  Gillett, P. T. MULTIPLE PURPOSE PLAN FOR RIVER-BOTTOM FARMING. Agr.
    Engin. 46(7): 388-390. $0.50. July 1965.

A condensation was given on multiple purpose planning for river bottom farming in the Arkansas River Valley.

For Sale, ASAE, 420 Main St., St. Joseph, Mich. 49085

# Hydrology

4.  Hobbs, H. W., and Crammate, F. B. HYDROLOGIC DATA FOR EXPERIMENTAL
    AGRICULTURAL WATERSHEDS IN THE UNITED STATES, 1960-61. U.S. Dept.
    Agr., Agr. Res. Serv. Misc. P. 994, 496 pp. 1965.

Selected hydrologic data for the calendar years 1960-61, inclusive, were presented. The data included: Monthly precipitation and runoff for 160 watersheds; annual maximum discharges and annual maximum volumes of runoff for 145 of the watersheds for time intervals of 1, 2, 6, and 12 hours and for 1, 2, and 8 days; and detailed information for one or more selected typical storm events for 133 of the watersheds.

Information on selected storm events included: (1) Tabular data for 30-day antecedent rainfall and runoff prior to the events; (2) data on rainfall and runoff intensity or rate for the event and on accumulated depths of rainfall and runoff; (3) description of watershed conditions at the time of the selected events; (4) graphs of hydrographs and rainfall histograms; (5) watershed maps; and (6) for some of the larger drainage areas, isohyetal maps of storm rainfall distribution.

For newly established watersheds, descriptions of watershed physical characteristics, instrumentation, graphs, maps, land management, and recommended area of application of the results were also given.

Tables, graphs, and charts.

Publication Editor, SWCRD, ARS, USDA, Beltsville, Md. 20705

5.  Davis, R. K. MANAGING THE WATER ECONOMY. J. Soil and Water Conserv.
    20(6): 247-250. 1965.

A detailed report was given on management of the water economy in the United States.

Resources for the Future, Inc., Washington, D.C.

6. DeCoursey, D. G. WATER YIELD COMPUTATIONS. Trans. ASAE 8(3): 367-370. 1965.

Developing dependable water supplies for small towns and private individuals from ephemeral surface flows requires estimates of total available yield. A procedure for making these estimates was presented.

The procedure was developed in connection with research on the hydrology of a selected reach of the Washita River in Oklahoma. A large dam is situated in this reach across one of the major tributaries, and its effect on the tributary outflow had to be determined. Since long-term flow records were not available, it was necessary to estimate the effect from available hydrologic data.

The procedure provided an estimate of the water yield of a reservoir fed by ephemeral flow. The methods outlined constitute a tool that may be used to make other preliminary estimates of water supply. The procedure was neither time consuming nor highly technical and gave reasonably accurate results.

The method was based on an analysis of available hydrologic data, physical characteristics of the reservoir, and probable management of the reservoir. Factors considered in the analysis were: Precipitation, evaporation, inflow, seepage, state-volume and stage-area curves, outflow, and projected-use rate.

The determination of each of these factors was discussed.

SWCRD, ARS, USDA, Chickasha, Okla. 73018

7. Striffler, W. D. THE SELECTION OF EXPERIMENTAL WATERSHEDS AND METHODS IN DISTURBED FOREST AREAS. Internatl. Assoc. Sci. Hydrol. P. 66: 464-473. 1965.

Mountain watersheds in many areas are undergoing severe mechanical disturbances such as intensive road construction and surface mining. Studies indicated the effects of such disturbances were directly related to the intensity or area of the disturbance. Maximum disturbances in small headwater watersheds have been found to be 7 percent for truck roads, 12 percent for truck and skid roads, and 40 percent for surface mines. Traditional research methods and criteria for selecting experimental watersheds may not apply in these areas.

Research methods for evaluating watersheds, have generally followed the following three basic approaches: Runoff plots; paired watersheds; and single watershed methods. These methods can be used under certain circumstances to evaluate watershed disturbances. However, a relatively new approach, the multiple watershed method, offers many advantages over traditional methods. In this method, a large number of nonuniform watersheds are selected. The parameter to be evaluated, (streamflow, sediment, etc.) becomes the dependent variable, which is statistically related to a number of independent variables such as watershed area, area of disturbance, etc. Advantages are that: (1) Results are applicable over broader regions; (2) there is more flexibility in selecting experimental areas; (3) downstream effects of disturbance can be determined; and (4) method is applicable on a sampling basis.

Central States Forest Expt. Sta., FS, USDA, Berea, Ky. 40403

8.  Brown, H. E. CHARACTERISTICS OF RECESSION FLOWS FROM SMALL WATER-
    SHEDS IN A SEMIARID REGION OF ARIZONA. Water Resources Res. 1(4): 517-
    522. 1965.

Recession flows from eight small watersheds in central Arizona were described and
differentiated on the basis of watershed precipitation and vegetative cover. Average or
"master" curves were prepared for each watershed and described in terms of standard
deviation and coefficient of variation of the slopes. Duration of master recessions, which
varied from 1 to 23 hours, depended on season and vegetation type. Maximum peak dis-
charges, which varied from 30 to 125 c.f.s./mi., usually came from summer rainstorms.
The steepest master recession slope was 1.6 on an upper woodland watershed for summer
storms; the most gradual was 0.1 for a pine forest watershed for winter-spring storms.

Rocky Mountain Expt. Sta., FS, USDA, 221 Forestry Bldg., Colo. State U., Fort Collins,
Colo. 80521

9.  James, L. D. NONSTRUCTURAL MEASURES FOR FLOOD CONTROL. Water Re-
    sources Res. 1(1): 9-24. 1965.

A workable procedure was devised for incorporating optimal amounts of nonstructural
measures in flood-control planning, determining proper project timing, and providing re-
view as new developments unfold. Optimality was based on the economic efficiency
criterion, or on minimizing the sum of the four flood-control cost components: Flood
damage; structural measure cost; the cost of floodproofing; and the cost of land use ad-
justment. Optimum timing was estimated by minimizing independently the total cost in
successive 10-year stages. Periodic review was obtained as the plan for each upcoming
stage was reviewed before it was applied.
    The technique was used to analyze a small watershed in Sacramento County, Calif.,
and it produced a flood-control program significantly less costly than that obtained by
current procedures. Structural measures for flood control were most applicable at the
two extremes of extensive agricultural or urban damages. Nonstructural measures were
favored in situations involving rapidly expanding urban development suffering fairly fre-
quent flooding or unusually costly structural measure construction. Residual flood dam-
ages were found to increase with time even after the optimum combination of structural
and nonstructural measures was applied.

U. Ky., Lexington, Ky. 40506

10. Rothacher, J. STREAMFLOW FROM SMALL WATERSHEDS ON THE WESTERN
    SLOPE OF THE CASCADE RANGE OF OREGON. Water Resources Res. 1(1): 125-
    134. 1965.

Streamflow from small watersheds on the western slopes of the Oregon Cascade
Range is strongly influenced by a maritime climate (wet winters and dry summers). Al-
though annual precipitation is high (94 inches in the study area), overland flow is almost
unknown.

Peak flows result largely from subsurface flow under conditions in which both retention and detention reservoirs are almost filled during extended periods of low-intensity rainfall. Under these conditions, vegetation appears to exert a minimum influence on high streamflow.

Lowest streamflow occurs from late August to mid-November and may follow a 60- to 100-day period with little or no rain. The dense vegetation of this part of the Douglas-fir region appears to exert its major influence at such times. Removal of vegetation from only 30 percent of a 250-acre watershed caused a 12 to 28 percent increase in minimum streamflow. On a 237-acre watershed on which 80 percent of the trees were cut, the increase in low flow was 85 percent.

Pacific Northwest Expt. Sta., FS, USDA, P.O. Box 3141, Portland, Oreg. 97208

11.  Sopper, W. E., and Lull, H. W.  STREAMFLOW CHARACTERISTICS OF PHYSIO-
       GRAPHIC UNITS IN THE NORTHEAST.  Water Resources Res. 1(1): 115-124.  1965.

An analysis was made to determine the amount of annual and seasonal water yield, flow duration, and peak flow frequency for seven major physiographic units in the northeast. All watersheds (137) in the northeast that were less than 100 square miles in area, that had continuous records from 1940-57, and that were not appreciably affected by regulation and diversion were included in the analysis. In addition, streamflows of four small forested experimental watersheds were compared with average streamflow values of the physiographic units in which they were located. The longest simultaneous record available was for a 3-year period from 1959-62. Significant differences in water yield were indicated between physiographic units as well as between watersheds within units. Water yields from the small experimental watersheds, although based on a shorter and different period of time, corresponded closely with average water yields of their respective physiographic units.

Pa. State U., University Park, Pa.  16802

12.  Brakensiek, D. L.  STORAGE FLOOD ROUTING WITHOUT COEFFICIENTS.  U.S.
       Dept. Agr., Agr. Res. Serv. ARS 41-122.  1966.

Flood routing methods that are based on the conservation of mass (continuity) and a single-valued relationship between depth of flow and flow rate are usually termed "storage flood routing" methods. This type of formulation was discussed more rigorously under the theory of kinematic waves.

A numerical method was presented for storage flood routing without coefficients. A number of flow problems were solved with a computer program. Some limitations of the kinematic formulation were illustrated by examples.

Publication Editor, SWCRD, ARS, USDA, Beltsville, Md.  20705

13. Columbus, N.  VISCOUS MODEL STUDY OF SEA WATER INTRUSION IN WATER
    TABLE AQUIFERS.  Water Resources Res. 1(1): 313-323. 1965.


An equation was developed for the length of sea water intrusion under conditions of
steady-state flow in unconfined coastal aquifers. A viscous flow model was used to verify
the equation for the length of salt water intrusion. Figures were constructed to show the
relationship between theoretical curves and experimental data.
    The experimental results were conclusive in proving the validity of this equation. The
equation appeared to be valid even when the Dupuit assumptions were no longer valid. It
was conjectured that this equation may be rigorously valid in spite of the fact that it was
derived on the basis of several simplifying assumptions. The theoretical profiles of the
fresh water-salt water interface reproduced closely the observed profiles. It was observed
that salt water moved toward the outlet along the zone of diffusion toward the outflow sec-
tion. This observation confirmed previous flow-net analysis.


N. Mex. Inst. Mining and Tech., Socorro, N. Mex.  87801


14. Robins, J. S., Kelly, L. L., and Hamon, W. R.  REYNOLDS CREEK IN SOUTHWEST
    IDAHO: AN OUTDOOR HYDROLOGIC LABORATORY.  Water Resources Res. 1(3):
    407-413. 1965.


The 93-square-mile experimental watershed in Reynolds Creek is aimed toward the
solution of water yield, flood flow, and sedimentation problems of the plateau and foothills
grazing areas of the Northwest. This watershed was selected in 1960 specifically to permit
experimental isolation of the several factors affecting the well-known water balance
equation. Basic networks for measurements and compilation of inventories of soils, vege-
tation, surface geology, and topography have been substantially completed. Detailed studies
on small, simple watersheds with identifiable characteristics will provide basic under-
standing of hydrologic processes, which can be tested on the larger, complex subwater-
sheds of the Reynolds Creek basin.


W. R. Hamon, SWCRD, ARS, USDA, Boise, Idaho.  83701


15. Helvey, J. D., and Patric, J. H.  CANOPY AND LITTER INTERCEPTION OF RAIN-
    FALL BY HARDWOODS OF EASTERN UNITED STATES.  Water Resources Res.
    1(1): 193-206. 1965.


All available reports of rainfall interception by hardwoods of Eastern United States
were reviewed and, where possible, combined. Results from these independently designed
and analyzed experiments showed that hardwood throughfall and stemflow varied over a
surprisingly narrow range. Combined regression analysis described the relation between
inches of gross rainfall (P), throughfall (T), and stemflow (S) for summer as $T = 0.901P-
0.031$, $S = 0.041P-0.005$; for winter as $T = 0.914P-0.015$, $S = 0.062P-0.005$. These equa-
tions can be modified for specified forest conditions or for use with seasonal rainfall.
A total of 15 standard gages were found necessary to sample the growing season throughfall
within 5 percent error limits, and 6 were necessary for the dormant season. Hardwood

litter interception, studied inadequately in most parts of the East, amounted to 2 to 5 per-
cent of the annual rainfall in the southern Appalachians. Applicability of equations to re-
search and to practical problems was discussed as well as need for further research.


Southeastern Forest Expt. Sta., FS, USDA, Asheville, N.C. 28802


16. Stephens, J. C., and Mills, W. C. USING THE CYPRESS CREEK FORMULA TO ESTI-
    MATE RUNOFF RATES IN THE SOUTHERN COASTAL PLAIN AND ADJACENT
    FLATWOODS LAND RESOURCE AREAS. U.S. Dept. Agr., Agr. Res. Serv. ARS
    41-95, 17 pp. 1965.


The Cypress Creek formula, $Q = C M^{5/6}$, gives reliable estimates of maximum 24-
hour-average runoff rates for small agricultural watersheds in the flatwoods regions of
the Gulf Coast, Atlantic Coast, and southern Florida, and in the Southern Coastal Plain--
wherever rainfall excess can be determined for the maximum 24-hour storm.
   Values of the coefficient C can be obtained with reasonable accuracy from the re-
lationship $C = 16.39 + 14.75 R_e$, where $R_e$ is rainfall excess in inches.
   Relating rainfall excess to probable recurrence periods requires judgment and knowl-
edge of the capacity for infiltration of the soils involved. However, a useful estimate of
rainfall excess is obtained in many instances by subtracting approximately 3 inches from
the predicted maximum 24-hour-storm rainfall.


Publication Editor, SWCRD, ARS, USDA, Beltsville, Md. 20705


17. Amerman, C. R. THE USE OF UNIT-SOURCE WATERSHED DATA FOR RUNOFF
    PREDICTION. Water Resources Res. 1(4): 499-507. 1965


The conceptual model upon which studies of hydrologic relations between unit-source
and complex watersheds are based was discussed. Comparisons of measured storm runoff
from two complex watersheds with that predicted by combining storm runoff of representa-
tive unit-source watersheds in accordance with the conceptual model revealed that the
measured values were different from those predicted. Within the framework of the present
model, unit-source watersheds cannot be used to predict the effects of land use changes on
complex watersheds. If the unit-source concept is to find effective application, an im-
proved model must be developed. The following phenomena that seem necessary in a more
realistic model were discussed: (1) Interflow; (2) partial area runoff production; and (3)
the influence upon downslope runoff production of runoff from upper slopes.


SWCRD, ARS, USDA, Coshocton, Ohio. 43812


18. Holtan, H. N. A MODEL FOR COMPUTING WATERSHED RETENTION FROM SOIL
    PARAMETERS. J. Soil and Water Conserv. 20(3): 91-94. 1965.


The infiltration approach to estimation of water retention by soils has not been ex-
tensively used in watershed engineering by the U.S. Department of Agriculture. The major

difficulty has been in obtaining reliable soil parameters as a basis for estimating infiltration capacity rates. The author concluded that volumes of soil storage capacities are finite and, therefore, more amenable to accurate determination than are infiltration rates. If the limiting volume is known, it places a ceiling on errors that might occur through application of erroneously estimated rates.

The use of volumes opens new possibilities for applying information we already have, or can readily determine, about soils and vegetation in squeezing the infiltration capacity estimate between enveloping limits. This concept also identifies and delineates problems in watershed hydrology in a form conducive to interdisciplinary participation.

SWCRD, ARS, USDA, Beltsville, Md. 20705

19. Rothacher, J. SNOW ACCUMULATION AND MELT IN STRIP CUTTINGS ON THE WEST SLOPES OF THE OREGON CASCADES. U.S. Forest Serv. Res. Note PNW-23, 7 pp. 1965.

In recent years, timber harvesting in Oregon has been extended to the upper edge of the commercial timber zone and even into the subalpine zone on the west slopes of the Cascade Range. Moderately heavy snowpacks present some possibilities for cutting practices to aid in better distribution of streamflow through delay of snowmelt runoff.

Because of the maritime climate, characterized by wet winters and dry summers, streamflow from drainages on the west slopes of the Oregon Cascades is poorly distributed throughout the year. Minimum flows occur during mid to later summer when water is most in demand by downstream users. The applicability of some of their recommendations for strip cutting to delay snowmelt under Oregon climatic conditions was studied.

First-year results from snow measurements in 2-chain-wide, east-west, clearcut strips showed greater accumulation of snow but more rapid melt. At the time of maximum accumulation in March 1964, water content of snow in the clearcut strip was 35 percent greater than that under the undisturbed forest. By June 15, only 3 of 36 plots in the open were snow covered in contrast to 26 of 36 plots snow covered under the undisturbed forest.

Pacific Northwest Expt. Sta., FS, USDA, P.O. Box 3141, Portland, Oreg. 97208

20. Miller, D. H. INTERCEPTION PROCESSES DURING SNOWSTORMS. U.S. Forest Serv. Res. Paper, PSW-18, 24 pp. 1965.

Four processes were identified as determining the initial interception of falling snow by forest during storms: Delivery of snow particles from the airstream to the forest; true throughfall of particles to the forest floor; impaction and adhesions of particles to foliage and branches; and cohesion of particles into masses of snow. Delivery and impaction processes seem amenable to aerodynamic analysis; adhesion of particles and cohesion both depend on air temperature and foliage roughness. Promising leads for laboratory and field research on aerodynamic and thermodynamic factors influencing interception were described.

Pacific Southwest Forest and Range Expt. Sta., FS, USDA, Berkeley, Calif. 94701

21. Hutchison, B. S. SNOW ACCUMULATION AND DISAPPEARANCE INFLUENCED BY BIG SAGEBRUSH. U.S. Forest Serv. Res. Note RM-46, 7 pp. 1965.

Studies are underway to determine the effects of sagebrush eradication upon snow-accumulation patterns and water yields. To aid in evaluating these studies, more detailed

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studies of various hydrologic processes on these lands are being made. During the winter and spring of 1963, the influence of natural grassland and big sagebrush upon snow accumulation, snow pack profile characteristics, and snow disappearance was compared. The author concluded that:

1. In areas where induced snow accumulation by topographic configuration was negligible, significantly more snow accumulated in sagebrush-covered areas than in comparable grass-covered areas because of the efficiency of sagebrush crowns in inducing deposition of drifting snow.
2. Continuous layers of ice observed during a considerable portion of the snowmelt period over soil and within the snowpack on grass-covered areas may change the hydrology of high-elevation grazing lands when sagebrush is eradicated.
3. The hydrologic importance of the characteristic melt pattern in sagebrush should be further investigated. The trapping of snow in the depressions after spring snow falls may be important in terms of water yields.

Rocky Mountain Forest and Range Expt. Sta., FS, USDA, Fort Collins, Colo. 80521

# Geology

22. Parsons, D. A., Apmann, R. P., and Decker, G. H. THE DETERMINATION OF SEDIMENT YIELDS FROM FLOOD WATER SAMPLING. Internatl. Assoc. Sci. Hydrol. P. 65: 7-15. 1965.

Measurements and studies of the solids content of flood waters from three watersheds of about a hundred square miles area in western New York suggested the need for additional information in order to discern even major differences in watershed erodibility with short periods of observation. The information needed consisted of: (1) Flood flow rates at the time and place of flood water sampling; (2) flood water temperatures; (3) dryness of the soil in the sediment source areas prior to the flood; and (4) location of the major source of the flood waters, if erodibility varies over the watershed. Items (2) and (3) may be replaced by the establishment of a seasonal trend in sediment concentration values.

Comparisons of the solids concentrations in concurrent floods in the three streams showed relative changes of about 40 percent due to streambank stabilization work in Buffalo Creek. About the same changes were indicated by the analysis of the Buffalo Creek data alone when flow rate, flood water source, and season were considered.

The latter method involved the following concepts: (1) The rates and amounts of runoff were unchanged during the period of observation; (2) the concentration of solids in the flood waters was related to the rate of flow, $Q$, such that $c = Kf(Q)$; (3) the $f(Q)$ reflects the erosiveness of the flood waters over the sediment source areas; and (4) the $K$ is an indicator of the erodibility.

Seasonal variations in mean values for $K$ suggested temperature and antecedent moisture effects upon erosion like those recently found by experiment at the USDA Sedimentation Laboratory. Mid-August values were about three times greater than those for January.

SWCRD, ARS, USDA, Oxford, Miss. 38655

23. Stein, R. A. LABORATORY STUDIES OF TOTAL LOAD AND APPARENT BED LOAD. J. Geophysical Res. 70(8): 1831-1842. Apr. 1965.

An analysis was given of the results of 59 flume experiments conducted in a 100-foot recirculating flume at the Sedimentation Laboratory at Oxford, Miss. Studies were made of total bed material transport as determined by fractional sampling, static and dynamic dune properties, and head losses encountered by flow over an alluvial bed. Total load and bed load appeared to be determined by mean velocity alone when moving dunes were present on the bed. If mean velocity was larger than the value producing minimum bed friction factor, total load then became a function of mean bed shear stress alone. The value of the variable was related rather well to the type of bed form, mean dune height, and the Darcy-Weisbach friction factor relative to the bed.

A limited comparison between bed material and bed load transport rates with those predicted according to various formulas showed the Schoklitsch formula to have the best balance between accuracy and ease of computation.

SWCRD, ARS, USDA, Oxford, Miss. 38655

24. Harder, A. H. MEASUREMENT OF GAS IN GROUNDWATER. Water Resources Res. 1(1): 75-82. 1965.

Two methods were used to detect the presence of methane gas in water from wells in southwestern Louisiana. A commercially developed combustible gas indicator proved reliable when using proper collection and analytical techniques and mathematical formulas, provided no hydrocarbons other than methane were present.

Data obtained from a gas-entrapment device showed that methane was the only hydrocarbon occurring in these waters. Values obtained for the quantity of methane present utilizing both methods agreed within 10 percent. The equations utilized in calculating the amount of methane were derived to aid the better understanding of the use of these two methods and to demonstrate what physical constants were used.

La. State U., University Station, Baton Rouge, La. 70803

25. Knisel, W. G., Jr. GROUNDWATER STUDIES IN THE EDWARDS PLATEAU OF TEXAS. U.S. Dept. Agr., Agr. Res. Serv. ARS 41-100, 12 pp. 1965.

Groundwater studies in the Lowrey Draw watershed in Sutton County, Tex., indicated that large volumes of water were rapidly transmitted underground by caverns and solution channels in the bottoms of stream channels and flood detention reservoirs. Groundwater observation well data near a floodwater detention reservoir indicated that water transmitted underground went directly to groundwater. Water table fluctuations indicated that caverns upstream from the reservoir transmitted small amounts of streamflow to the aquifer before inflow to the reservoir was observed. Groundwater recharge from rainfall passing through the soil and rock mantle was slow and could continue for a period of time after rainfall, whereas recharge from reservoir storage was of short duration and a definite groundwater mound could be detected in observation wells.

The runoff volumes during the September storms were of such small magnitude that sediment deposition in the reservoirs was not significant.

Data were insufficient to be conclusive or to permit development of any relations at this time. However, the data collection program initiated provides estimates of groundwater recharge possibilities in connection with flood detention structures. The research

data will also help groundwater hydrologists determine the feasibility of establishing reservoirs primarily for groundwater recharge.

SWCRD, ARS, USDA, Beltsville, Md. 20705

# Engineering Design

26. Parsons, D. A., and Apmann, R. P. CELLULAR CONCRETE BLOCK REVETMENT. Civil Engin. 35(2): 6. 1965.


An experimentally designed and placed stream-bank protection of cellular concrete blocks has successfully withstood flood flows for 8 years on Buffalo Creek near East Aurora in western New York. The precast cell units are 16 x 24 in. and 4 in. thick, each with 24 holes 2 x 2 in. in size. They were placed close together on a carefully sloped bank at a bend in the creek that is subject to erosive stream action. Part of the bend was protected by quarried riprap stone of 17-in. median size.

The cellular blocks were placed on the soil in situ in 1956-57. Holes in the blocks were filled with sand and gravel of varying sizes. Indications were that larger filling material was better and that it probably was cheaper and better to spread about 0.1 cu. yd. per sq. yd. of sand as a bed for the blocks rather than to try for very accurate bank shaping.

Cellular revetments acted differently from continuous slab revetments. Subgrade material, and eventually vegetation, will be established in holes above the water level. Articulation permits the mat to deform with subgrade changes.

The total cost of installing the experimental concrete revetment in 1956 was about $12.50 per sq. yd.

Observations of flood flows and subsequent damage to the experimental concrete-block revetment over the past 8 years have demonstrated its satisfactory performance under severe conditions.

SWCRD, ARS, USDA, Oxford, Miss. 38655

27. Matalas, N. C., and Conover, W. J. DERIVATION OF THE VELOCITY PROFILE FROM A STATISTICAL MODEL OF TURBULENCE. Water Resources Res. 1(1): 235-261. 1965.


A statistical model of turbulence for two-dimensional uniform flow in open channels was developed. This model was used to derive the vertical velocity profile. This profile was defined by a three-parameter hyperbolic function, with two parameters reflecting the effect of bed roughness and fluid viscosity on the shape of the profile. The third parameter is the mean velocity in the vertical. The hyperbolic function was fitted to velocity data for water in natural channels, a laboratory flume, and air in a wind tunnel. A brief comparison of the hyperbolic function with the logarithmic function was given.

U.S. Geol. Survey, Washington, D.C. 20240

28. Hantush, M. S. WELLS NEAR STREAMS WITH SEMIPERVIOUS BEDS. J. Geophysical Res. 70(12): 2829-2838. 1965.

Currently used formulas for the drawdown distribution and the rate and total volume of river depletion resulting from wells pumping nearby were based primarily on the assumption that the bed of the stream is as permeable as the aquifer it completely cuts through. These formulas were empirically modified to be approximately applicable when the stream bed is semipervious and is partially penetrating the aquifer. This modification was based on the assumption that the resistance to flow due to the partial penetration and the semiperviousness of the stream bed can be reasonably replaced by its equivalent owing to flow through a horizontal additional stretch of the main aquifer. This additional length is determined empirically by using pumping test data in conjunction with the drawdown equation for the substitute system.

The resistance to flow due to the semiperviousness of the bed of the stream was replaced by an equivalent resistance due to a horizontal flow through a semipervious layer of insignificant storage capacity which is lying between the aquifer and the channel of the stream. It was believed that this approach is closer to reality and, consequently, should yield flow formulas that reproduce the flow conditions in the actual system more closely. Except for the unsteady drawdown equation, this approach has led to flow equations that were as easy as their counterparts now in use. Tabulation of the function involved in the unsteady drawdown equation was not difficult and, once completed, the equation became as easy to use as any other simple formula. Quantitative comparison between results of the old and the new approaches were presented graphically. A procedure using the steady-state drawdown equation was outlined for obtaining the transmissivity of the aquifer, the effective distance to the stream, and the "retardation coefficient" of the channel lining.

N. Mex. Inst. Mining and Tech., Socorro, N. Mex. 87801


29. Ree, W. O. SWISS CHANNEL-TYPE GAGING STATIONS. U.S. Dept. Agr., Agr. Res. Serv. ARS 41-105, 10 pp. 1965.

The water-measuring stations described were developed by the Switzerland Federal Service of Hydraulic Economy. Detailed plans, photographs, and rating curves for four stations were studied and abstracted for presentation.

These stations were developed to measure water in mountain streams having a heavy bedload, particularly during flood states. An essential performance requirement for the station was that this bedload should not be deposited in the structure when the flow decreased. Performance of the flumes indicated that this requirement was met. In design principle, these flumes are like the Tombstone Flumes which also have shown freedom from deposition.

Each station was described separately. Along with the description was a sketch of the station, a photograph, and an estimated rating curve. For the purpose of estimating the head-discharge relationship, the water was assumed to be at critical depth at the upper end of the straight part of the station. Then the water-surface profile was calculated from this point to the measuring section to obtain the estimate of head for a selected discharge. The plotted points on the rating curves were obtained from current meter measurements. The points represent the actual rating for the station; the curve was extended to provide an estimate of the head-discharge relationship in the ungaged range.

Publication Editor, SWCRD, ARS, USDA, Beltsville, Md. 20705

30. Blaisdell, F. W., and Crist, S. D. A DIGITAL POINT GAGE RECORDER. U.S. Dept. Agr., Agr. Res. Serv. ARS 41-102, 20 pp. 1965.

Equipment for recording point gage readings directly on punched tape in a form suitable for use by a digital computer was described and illustrated.

The components of the digital point gage recorder include a point gage, gears to convert point gage linear motion to rotation of a shaft, an analog-to-digital converter (encoder) to change the angular position of the shaft into a coded digital output, a control cabinent to read the converter, and a tape punch to record the coded readings on paper tape. A keyboard on the control cabinet permits the entry of certain data on the paper tape more conveniently than through the point gage.

Readout is initiated by the observer's pushing a switch button. The readout time is less than 1 second.

The equipment is adaptable for recording any information that can be converted into a shaft rotation.

The report consists of a description of: (1) The design and operation of the digital point gage recorder; (2) operational difficulties and adjustments; and (3) performance checks.

Publication Editor, SWCRD, ARS, USDA, Beltsville, Md. 20705


31. Charmonman, S. A SOLUTION OF THE PATTERN OF FRESH-WATER FLOW IN AN UNCONFINED COASTAL AQUIFER. J. Hydraul. Res. 70(12): 2813-2819. 1965.

Fresh-water steady flow in an unconfined coastal aquifer satisfies Laplace's equations in a domain, two of whose boundaries are free surfaces, the upper boundary being the interface between air and fresh water and the lower boundary being the interface between fresh water and salt water. A method of solution based on observations of the governing equation and boundary conditions in the complex potential plane were used. Solution of the two-free-surface problem was presented in a dimensionless form. The validity of the method of solution was tested by supplying it to the problem of fresh-water pattern in a confined coastal aquifer which is a problem with a single free surface.

The solution of the single-free-surface problem obtained by the present method agreed exactly with that published by others. Comparisons of the two problems confirmed that the solution of the problem in a confined aquifer can be used satisfactorily for practical purposes as an approximate solution to the problem in an unconfined aquifer. If the ratio of specific weight of salt water to that of fresh water was assumed to be 1,025, the upper free surface was in error by an amount less than 1.3 percent; the lower free surface and the outflow face were in error by less than 2.6 percent.

McMaster U., Hamilton, Ontario, Canada.


## Snow Surveys

See Also 25.

32. Haskell, E. E., Jr., and Bianchi, W. C. DEVELOPMENT AND DISSIPATION OF GROUND WATER MOUNDS BENEATH SQUARE RECHARGE BASINS. J. Amer. Water Works Assoc. 57(3): 349-553. 1965.

The shape and size of the ground water mound are important in the selection and evaluation of a recharge facility. The rate of rise, height that the mound reaches, and its lateral extent may become of concern in the operation of the recharge facility. A reasonable first step in the geometric description of the mound associated with a recharge basin is the instrumentation and observation of a field location through a recharge cycle. A square 2-acre plot was instrumented to obtain field information. The following conclusions were made regarding the development and dissipation of ground water mounds formed beneath square recharge plots with limiting surface intake rates:

1. A "sigmoid-conical-shaped" mound resulted (as the mound did not rise to the surface).
2. Soil profile variations in layering and texture did not appreciably distort the symmetry of the mound.
3. The rate of rise was relatively rapid compared with the dissipation.
4. A significant rise in the water table occurred at a distance of one plot width from the edge of the recharge basin.
5. Anisotropic permeability distribution below the existing water table was not the cause of distortion in mound shape at equilibrium.

SWCRD, ARS, USDA, Fresno, Calif. 93726

# WATER MANAGEMENT
## Irrigation

See Also 5, 65, 66, 72, 77, 82, 86, 108, 169, 182, 187, 189, 195, 203, 206, 214, 248, 252, 258, 273, 276.

33. Krogman, K. K., and Hobbs, E. H. EVAPOTRANSPIRATION BY IRRIGATED ALFALFA AS RELATED TO SEASON AND GROWTH STAGE. Canad. J. Plant Sci. 45(4): 309-313. July 1965.

Where three levels of irrigation were applied during three successive summers, the average daily rates of evapotranspiration by alfalfa ranged from 0.05 to 0.36 inches per day. The maximum evapotranspiration rate was associated with complete ground cover and at this stage equalled potential evapotranspiration. Except for early in the season, the conversion factor for estimating evapotranspiration from evaporation for irrigation scheduling by the budget method or soil moisture balance sheet should approximate the potential evapotranspiration-evaporation ratio.

Res. Sta., Dept. Agr., Lethbridge, Alberta, Canada.

34. Bondurant, J. A., and Willardson, L. S. RECIRCULATING FARM IRRIGATION SYSTEMS. Amer. Soc. Civil Engin., Irrig. and Drain. Specialty Conf. "Development of the Total Watershed" Proc., Billings, Mont., pp. 243. 1965.

A survey of systems for recirculating runoff water from irrigation in southern Idaho showed little evidence of formal system design. Systems were constructed to handle approximately 20 percent of the volume of irrigation water. Costs of the systems varied with the

type of installation. Sequence, reservoir, and cycling sump systems each had certain advantages. Recirculating systems were not effective unless the water was applied to a different area than that which was contributing runoff. Recirculating irrigation systems can raise water application efficiencies to 80 percent.

SWCRD, ARS, USDA, Twin Falls, Idaho. 83301

35. Korven, H. C. TIME-AND-MOTION STUDY OF UNDERTREE AND OVERTREE SPRINKLER-IRRIGATION SYSTEMS. Trans. ASAE 8(4): 502-504, 507. 1965.

In a study of time and motion of undertree and overtree sprinkler--irrigation systems for fruit crops, the author concluded that:

1. The portable-pipe system was not recommended for overtree irrigation because it took longer to move and was limited to across-the-row movement.
2. The pull-type systems were not recommended for overtree irrigation of dwarf fruit trees and grapes because the maximum width of move possible was from one panel to the next, or 15 feet, which was not sufficient.
3. The tractor--pull, skid-move system was recommended for undertree irrigation because it gave the desired spacing in mature orchards and saved moving time.
4. The hand-pull wheel system was not recommended for the following reasons: (1) Too heavy to pull by hand. A 200-foot line was about the limit when pulling the line through a clover crop on level ground. (2) The time required to drain the pipe line was a definite handicap. And, (3) the initial cost was about 1 1/2 times the cost of the tractor-pull skid move.
5. The hose system was recommended for overtree irrigation of dwarf fruit trees and vineyards because this system was the only one of those studied that was applicable to along-the-row movement.
6. The 110-foot hose system was recommended over the 50-foot hose system because of a saving of time and reduced initial cost.
7. The quick-coupling connection was too expensive to be recommended.
8. Plastic hose was tentatively recommended because it cost 30 percent less and was lighter in weight than rubber hose.
9. Even though it took slightly longer, the double move was preferred to the single move as it overcame the problem of the long move.

Canada Dept. Agr., Swift Current, Saskatchewan, Canada.

36. Pohjakas, K. MEASURING IRRIGATION WATER LOSSES THROUGH BORDER DYKES. Canad. Agr. Engin. 7(1): 28-29. 1965.

In border dike irrigation systems, some of the irrigation water is lost through and below dikes, and it becomes unavailable to the crop.
A sampling program was designed and conducted to provide data to calculate border losses from the gravimetric soil moisture determinations. The author concluded that:

1. The average water losses for each pair of duplicate plots varied from 9.83 to zero pounds of water per lineal foot of dike. Generally high losses occurred from plots that contained higher soil moisture prior to irrigation. Also, higher application rates tended to contribute more heavily to border losses.
2. The average losses from plots were: Perennial crops, 4.20; cereal crops, 3.81; and row crops, 2.37 pounds of water per lineal foot of dike. The average water loss for all crop and application rates was 3.47 pounds per lineal foot of dike. This loss was about 3 percent of the water applied to a 30- x 30-foot diked plot.

3.  The sampling and calculating technique provided data on the magnitude of water losses from border diked areas on a fine sandy loam to fine sand soil. The errors in consumptive use studies arising from water lost outside of a border diked area were about equal to errors involved in determining soil moisture by the gravimetric sampling technique. Border dikes were efficient barriers to the lateral movement of water.

Canada Dept. Agr., Expt. Farm, Swift Current, Saskatchewan, Canada.

37.  Gray, D. M., and Ahmed, M.  RATIONAL APPROACH APPLIED TO THE DESIGN OF BORDER DYKE SYSTEMS.  Canad. Agr. Engin. 7(1): 30-33, 44.  Jan. 1965.

An attempt was made to demonstrate the application of a rational approach, based on the conservation of mass, to the analysis and design of border dike irrigation systems. Theoretical expressions were developed which permitted the evaluation of the soil intake rate characteristics from measurements of inflow to the strip, advance of the wet front, and the time-rate of accumulation of surface storage.

The parameters of the intake rate equation, $f = K^n$, were evaluated from the expressions by the use of experimental data collected from several existing border dike systems. The validity of these determinations was tested by comparing observed rate of advance curves with calculated rate of advance curves derived by substitution of the equations of intake into an equation of advance proposed by Christiansen, Bishop, and Fok. In all cases, the agreement between calculated and observed curves was very good.

Close agreement was obtained between the average depths of water applied, as calculated using the soil intake rate determinations, and rate of advance and recession curves, as compared with depths obtained by soil moisture measurements.

U. Saskatchewan, Saskatoon, Saskatchewan, Canada.

38.  Sulek, J. J.  OPERATIONAL CHARACTERISTICS OF PROPANE IRRIGATION ENGINES. Trans. ASAE 8(3): 431-432, 436.  1965.

In a study of the operational characteristics of propane irrigation engines, the author concluded that:

1.  The fuel economy of efficient propane engines operated in the 60- to 80-p.s.i. brake mean effective pressure load range was between about $9.7 \pm 0.5$ hp.-hr. per gallon when properly adjusted.
2.  Correct carburetor adjustment resulted in an average 3-percent increase in fuel economy with a range from 0 to 18 percent.
3.  No measurable increases in fuel economy were obtained with changes in ignition because the manufacturers' ignition timing specifications were closely followed by the service men.
4.  Incomplete data on the life of major engine parts indicated that properly loaded and maintained propane irrigation engines operated about 5,000 hr. before a major overhaul was required.
5.  The initial fuel economy was maintained for the duration of the test when the engines were properly adjusted and maintained.

U. Nebr., Lincoln, Nebr.  68503

39. Garton, J. E., and Mink, A. L. SPATIALLY VARIED FLOW IN AN IRRIGATION DIS-
    TRIBUTION DITCH. Trans. ASAE 8(4): 530-531. 1965.

The theoretical depths of flow in a slip-formed concrete ditch in which the elevation of
the water surface was equal at the ends of the discharge bay were determined for various
values of roughness, tube discharge, tube number, and $\alpha$, considering the problem as one
of spatially varied flow.

Reference values for $\alpha$ and n were not available for this type of ditch.

This investigation indicated that field ditches could be constructed as a series of level
bays with a resulting increase in the uniformity of water application. Ditches designed using
these procedures would usually result in shallower depths than are currently used.

Okla. State U., Stillwater, Okla. 74075

40. Holmen, H. POLYETHYLENE LININGS FOR IRRIGATION DITCHES. N. Dak. Farm
    Res. 23(11): 11-16. 1965.

Surface Linings--Black polyethylene plastic used for surface linings of irrigation ditches
was quite easily damaged. The 4 mil thickness serviceable for one irrigation season, and
the 10 mil thickness probably would give good results for seepage control for at least two
irrigation seasons.

The plastic linings can be joined or patched with a liquid adhesive for bonding polye-
thylene and a covering of pressure sensitive tape over the joint.

Animals must be kept away from surface linings because they cause extensive damage
when they walk on the linings.

Disposal of used linings was a problem because they did not ordinarily rot or decay.

Subsurface Linings--Polyethylene linings covered with a layer of soil were serviceable
for many years in controlling seepage. However, they did not provide erosion or weed con-
trol benefits when they were underground.

At the end of a 4-year period of use, a 6 mil thickness was just as effective as a 10 mil
thickness for preventing seepage.

A ditch with buried linings should be treated as an unlined earth ditch in its mainte-
nance and operation.

N. Dak. Agr. Expt. Sta., N. Dak. State U., Fargo, N. Dak. 58103

41. Bloom, W. M. IRRIGATION PERFORMANCE OF FIBRE PIPE. Irrig. Engin. and
    Maintenance. 15(4): 14-15. 1965.

In a study of the irrigation performance of fiber pipe at the Tidwell irrigation test
project, the authors concluded that:

1. Fiber pipe could be used economically to carry water from a point of supply to a point
   of usage.
2. Fiber pipe joints did not leak.
3. Fiber pipe maintained its circular form when properly installed.
4. A system when properly engineered operated economically.
5. Fiber pipe was installed in the ground under pressure for over 5 years without dete-
   rioration to the product or of its strength characteristics.
6. The flow characteristics did not change over an extended period of time but continued
   to be excellent.
7. The pipe could remain full of water without any detrimental effects.
8. The pipe could be alternately wet and dry without any detrimental effects.

9. Fiber pipe was not affected by water hammer in a system with properly designed and placed standpipes.
10. Mastics were not necessary for water-tight fiber pipe joints.

Low friction loss, virtually constant over the life of the pipe, made possible the use of smaller, less costly water pumps.

Lightweight, 10-foot lengths joined by merely driving on a $2^O$ tapered coupling, speeded the laying time and permitted immediate backfilling and dressing of the construction site.

No address given.

42. Kruse, E. G. THE CONSTANT-HEAD-ORIFICE FARM TURNOUT. U.S. Dept. Agr., Agr. Res. Serv. ARS 41-93, 24 pp. 1965.

The constant-head-orifice turnout, a structure used for the control and measurement of irrigation water, was calibrated and evaluated in the laboratory. The effects were studied on discharge of sediment, high canal velocities, varying downstream water levels, and plugging of the orifice gate by debris.

The calibration of the constant-head-orifice turnouts, constructed with several different geometries and operated under several flow conditions, did not vary greatly from the calibration of similar structures reported by the U.S. Bureau of Reclamation (USBR). Under most conditions, these constant-head-orifice turnouts provided accurate measurement and regulation of irrigation water discharges.

A constant-head-orifice constructed of steel modular panels also served as a suitable water measurement device. The accuracy of measurement was not as good as with the USBR gates. Weeds or other obstructions in the orifice gate opening caused reduction in discharge of 40 percent or more. Sediment diverted into the turnout was not deposited near the orifice gate.

High velocities of flow in the canal past the entrance to the turnout did not cause consistent effects on the calibration for the smaller gate openings. For large orifice-gate openings, increasing canal velocity caused a decrease in the discharge coefficient.

An increase in tail water elevation after the openings of the gates and the differential head had been set caused a significant decrease in the discharge.

The coefficient of discharge was nearly constant when the ratio of the water depth immediately upstream from the orifice gate (d) to the height of the gate opening (a) was greater than 4.0. For smaller ratios the discharge coefficient increased rapidly.

Publication Editor, SWCRD, ARS, USDA, Beltsville, Md. 20705

43. Haise, H. R., Kruse, E. G., and Dimick, N. A. PNEUMATIC VALVES FOR AUTOMATION OF IRRIGATION SYSTEMS. U.S. Dept. Agr., Agr. Res. Serv. ARS 41-104, 21 pp. 1965.

Several models of a pneumatic nylon-reinforced valve for remote control of water application from underground pipeline or open ditch distribution systems were described and illustrated. Basic components of the system included: (1) A pneumatic closure; (2) a three-way solenoid valve that permits the flow of air into or out of the pneumatic closure; (3) a source of air pressure to inflate the closure; and (4) a centrally located remote control system with timing device to actuate the three-way solenoid control valve by means of a signal transmitted by radio or carried by wire. Preliminary results of field tests at Newell, S. Dak., demonstrated the feasibility of remotely controlling water applications on farm fields by radio up to distances of one-half mile.

Publication Editor, SWCRD, ARS, USDA, Beltsville, Md. 20705

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44. Taylor, S. A. MANAGING IRRIGATION WATER ON THE FARM. Trans. ASAE 8(3): 433-436. 1965.

Potential measuring instruments greatly simplified the problem of knowing exactly when and how much irrigation water to apply. The need for irrigation guides, detailed determinations of soil moisture content, and water-balance records from climatic data were eliminated with these devices. Anyone who can read an instrument and plot points on a chart, can do an acceptable job of scientific irrigation with these instruments.

Utah State U., Logan, Utah. 84321

45. Rollins, M. B. WATER QUALITY OF THE NEWLANDS RECLAMATION PROJECT. U.S. Dept. Agr., Agr. Res. Serv. ARS 41-97, 44 pp. 1965.

The irrigation water of the Newlands reclamation project is of good quality. The water has a medium salinity hazard and practically no sodium hazard. A moderate amount of leaching with this water should prevent any salt buildup in irrigated soils.
    Salinity of irrigation water increased slightly each year as the irrigation season progressed. Then salinity decreased as large volumes of low-salt spring runoff replenished the reservoir supply.
    The drainage waters contained higher concentrations of total salts and higher percentages of sodium than the irrigation water. These drainage waters varied in quality from a medium salinity and low sodium hazard to a very high salinity and sodium harzard.
    Drainage waters increased in salt concentration and percentage of sodium as they flowed downstream.
    Seasonal changes in quality were more pronounced with the drainage waters than with the irrigation water. At the termination of the irrigation season, the drainage waters increased sharply in total salts and continued to increase through the winter until irrigation was started again in the spring.
    It is a common practice in the Newlands reclamation project to use most drainage waters for irrigation. Some drainage waters are excellent for irrigation; others can be used successfully with careful management; and some drainage water should never be placed upon good land.
    The irrigation waters of the Newlands reclamation project should not harm most canal liners now in use, but some of the drainage waters, of high salt content, could shorten the life of some types of liners.
    Soil salinity and alkalinity are nearly stabilized on this project under the existing irrigation and drainage systems.

Publication Editor, SWCRD, ARS, USDA, Beltsville, Md. 20705

46. Forshey, C. G., and Dominick, B. A., Jr. IRRIGATION OF APPLES IN THE HUDSON VALLEY. N.Y. State Agr. Expt. Sta. (Geneva) B. 899, 30 pp. 1965.

The value of supplemental irrigation for apples in the Hudson Valley would appear to be dependent on the interaction of the following factors:

1. Cultural practices. Fertilization, fruit thinning, and pruning must be followed for maximum production.

2. Rainfall. Irrigation of apples was highly profitable in 1962, when rain during the growing season totalled 11.37 inches but not in 1959 when the total for May through September was 13.67 inches.
3. Soil type. The shallow and the coarse-textured soils were most susceptible to damaging soil moisture deficits. Apples sized surprisingly well on a good, deep loam in even the driest years.
4. Water supply. There should be sufficient water to apply 12 inches of water to an acreage large enough to support the irrigation system.
5. Varieties. The influence of varieties was expressed in the following two ways: (1) The potential physiological response of some varieties was greater than that of others. In the Hudson Valley, the greatest opportunity for successful irrigation was provided by such late season varieties as Delicious, Golden Delicious, and Rome Beauty. And (2) the income from irrigation was derived from an increase in yield and an increase in the market value of the fruit as represented by changes in size distribution of the fruit.
6. Market. Significant increases in fruit size were meaningless unless they could be converted to dollars. In years of short supply and unsatisfactory fruit size, the market readily absorbed the costs of irrigation, but in an unfavorable market it did not.

N.Y. State Agr. Expt. Sta., Geneva, N.Y. 14456

47. Robinson, F. E., and McCoy, O. D. THE EFFECT OF SPRINKLER IRRIGATION WITH SALINE WATER AND RATES OF SEEDING ON GERMINATION AND GROWTH OF LETTUCE. Proc. Amer. Soc. Hort. Sci. 87: 318-323. 1965.

Seeding rates and sprinkler irrigation were studied on lettuce in the Imperial Valley in California. The 3 lb./acre rate of lettuce seeding reduced the size and number of blank spaces in the seed row, as compared to the 0.7 and 0.5 lb. seeding rates, but had the highest thinning costs, the greatest incidence of midrib cracking, the latest date of maturity, and the least yield. The 0.7 and 0.5 lb./acre seeding rates were associated with the lower thinning costs in each irrigation treatment, earlier maturity, better quality, and higher yields than the 3.0 lb. seeding rate. The precision 0.5 lb./acre seeding rate showed the lowest thinning cost and earliest maturity of the three seeding rates. The combined 0.5 lb. acre seeding rate and sprinkler irrigation resulted in the most uniform growth rates, the least incidence of rib cracking, the earliest maturity, and the largest harvest taken in a single day.

U. Calif., Davis, Calif. 95616

48. Parks, W. L., Overton, J. R., Hazlewood, B. P., and Chapman, E. J. STARR MILLET YIELDS AS AFFECTED BY IRRIGATION AND NITROGEN. Tenn. Agr. Expt. Sta. B. 389, 13 pp. 1965.

Field experiments involving irrigation and nitrogen fertilization of the Starr variety of pearl millet were conducted on a Maury silt loam soil at the Middle Tennessee Experiment Station, and on a Memphis silt soil at the West Tennessee Experiment Station over a 5-year period (1957-61.) The authors concluded that:

1. Significant response of Starr millet to irrigation was obtained in only 2 of 10 crop years.
2. Nitrogen was the most limiting production factor for Starr millet on these soils.
3. Significant yield increases from nitrogen rates of 180 pounds per acre were obtained.

4. Millet seeded in late May produced more forage than millet seeded in early July.

U. Tenn., Agr. Expt. Sta., Knoxville, Tenn. 37901

49. High, T. W., Jr., Duncan, H. R., Felts, J. H., and High, J. W., Jr. PRODUCING
    YEARLING STEERS ON IRRIGATED BLUEGRASS-CLOVER AND ORCHARD-GRASS-
    CLOVER PASTURES. Tenn. Agr. Expt. Sta. B. 387, 19 pp. 1965.

A 7-year study of the comparative value of old stands of bluegrass-clover pastures
and improved orchardgrass-clover pastures for yearling steer production was conducted at
Greeneville, Tenn. The effects of irrigation on the productivity and costs of these two types
of pastures were also studied. The authors concluded that:

1. Daily gains of steers did not differ significantly ($P > .05$) regardless of treatment.
   Gains ranged from 1.43 to 1.50 pounds per head daily for the grazing season of ap-
   proximately 150 days.
2. Non-irrigated orchardgrass pastures produced 49 more animal grazing days per acre
   than did non-irrigated bluegrass pastures.
3. Although irrigation did not increase daily gains on either type of pasture, animal
   grazing days per acre were significantly increased due to irrigation. Irrigation did
   not prevent a summer slump in animal gains.
4. Pasture costs were increased $28 to $30 per acre annually where irrigation was used.
   The increased beef produced was not enough to meet this additional expense.
5. Weeds increased in the orchardgrass pastures and the stand became too thin for
   optimum production. The bluegrass pastures retained dense sods even though they
   had been established for many years.

U. Tenn., Agr. Expt. Sta., Knoxville, Tenn. 37901

50. Smika, D. E., and Newell, L. C. IRRIGATION AND FERTILIZATION PRACTICES FOR
    SEED PRODUCTION FROM ESTABLISHED STANDS OF SIDE-OATS GRAMA. Nebr.
    Agr. Expt. Sta. Res. B. 218, 11 pp. 1965.

Fertilization and irrigation requirements of side-oats grama grown in 40-inch rows
for seed production were studied for 3 years near Oxford, Nebr., and for 1 year at North
Platte, Nebr.

The number of spikes per raceme was not affected by treatments. The number of spike-
producing racemes per foot of row was altered by both irrigation and fertilization. Fall
and heading irrigations and 40 pounds of nitrogen per acre resulted in the greatest number
of racemes per foot of row.

Weight of whole spikes per raceme was increased 40 percent by two or more irriga-
tions when compared with no irrigation. Nitrogen fertilizer significantly increased whole
spike weights when seed of the fertilizer plots was harvested in soft dough stage of
maturity.

During the last 2 years of study at Oxford, 80 pounds of N per acre increased seed set
12 percent over that of the nonfertilized treatment. The number of caryopses per gram of
whole spikes were not affected by either fertilizer or irrigation. At North Platte, 40 pounds
of N produced the greatest increase in seed set.

Seed quality at Oxford was best with fall and heading irrigations and poorest with
fall-only irrigation. Both the 40- and 80-pound rates of nitrogen resulted in significant
increases in seed quality. Seed quality of both varieties at North Platte was highest from
the spring and heading irrigations and lowest with the fall-only irrigation.

Yield of commercially pure seed per acre was highest when irrigations were made in fall and again at heading. Application of 40 pounds of N per acre in conjunction with these two irrigations was the most favorable rate of fertilization.

U. Nebr. Col. Agr., Agr. Expt. Sta., Lincoln, Nebr. 68503

51. Dawson, J. H. COMPETITION BETWEEN IRRIGATED SUGAR BEETS AND ANNUAL WEEDS. Weeds 13(3): 245-249. July 1965.

Experiments of the following types were conducted: (1) Weeds were allowed to grow for different periods after planting sugar beets; they were then removed and the beets hand-weeded until harvest. (2) Sugar beets were hand-weeded for different periods after planting; then no further weeding was done. Weed competition reduced beet yields up to 94 percent. Weeds that emerged soon after beet planting reduced yields the most, but they exerted little yield-reducing competition until later than 12 weeks after planting the beets (9 weeks after beet emergence). Full-season weed control resulted when beets were hand-weeded for 10 to 12 weeks after planting. Weeds that emerged later were controlled by crop competition.

CRD, ARS, USDA, Irrig. Expt. Sta., Prosser, Wash. 99350

52. Lee, W. O. SELECTIVE CONTROL OF DOWNY BROME AND RATTAIL FESCUE IN IRRIGATED PERENNIAL GRASS SEED FIELDS OF CENTRAL OREGON. Weeds 13(3): 205-208. July 1965.

Downy brome (Bromus tectorum L.) was controlled by dicamba and prometryne. Both herbicides gave 70 to 100 percent control when applied soon after the first postharvest irrigation. Dicamba was somewhat less effective when applied before this irrigation. Neither herbicide reduced seed yields when applied before or immediately after the first post-harvest irrigation, but both herbicides caused some significant seed yield reductions when treatments were delayed until after considerable crop regrowth had occurred.

CRD, ARS, USDA, Corvallis, Oreg. 97331

53. Long, R. B. COST OF PUMPING IRRIGATION WATER IN TEN NEW MEXICO COUNTIES. N. Mex. Agr. Expt. Sta. B. 490, 43 pp. 1965.

Because of the increase in pump irrigation in New Mexico since 1954, a study was undertaken to determine the average costs in 10 counties, and the relation of these costs to pump yield.
Data were obtained by interviews with 254 farmers. Analysis of the data revealed the following average costs per acre-foot of water pumped in the study counties:

| | | | |
|---|---|---|---|
| Luna County | $11.63 | Lea County | $5.93 |
| Curry County | 9.86 | Chaves and Eddy Counties: | |
| Hildalgo County | 8.04 | Shallow wells | 5.63 |
| Roosevelt County | 8.04 | Artesian wells | 5.11 |
| Otero County | 7.19 | Dona Ana County | 4.12 |
| Torrance County | 6.75 | | |

Each county in the study was discussed in terms of its crops, physical irrigation characteristics, and costs.

Average costs per acre-foot were related to pump yields. Farmers can use this data to predict how their costs may increase or decrease as their pump yields change.

Tables and charts.

54. Madden, J. P., and Davis, B. ECONOMICS OF SIZE ON IRRIGATED COTTON FARMS OF THE TEXAS HIGH PLAINS. Tex. Agr. Expt. Sta. B. 1037, 11 pp. 1965.

The economics were standard of size available to irrigated cotton farms in the Texas High Plains.

The synthetic firm approach was used in this analysis. Farms of various sizes were constructed, assuming advanced technology and prices projected to 1968. Several different crop and live-stock enterprises and various cultural practices were included. Gross income was used as the measure of output. Linear programming was used to determine the least-cost farm plan for each of several levels of output. Short-run average cost curves were calculated for different farm sizes, and the envelope curve was developed from these short-run curves.

Recent trends indicated that cotton farms in the Texas High Plains were extending their acreage beyond the least-cost point at 440 acres of farmland. In moving to larger sizes, farms did not achieve lower average costs or greater efficiency. But they did achieve greater profit. A one-man operation with six-row machinery could produce almost $60,000 gross income on a 440-acre farm. Net profit, or return to the operator's management, would be $17,400. This profit was over and above the return to the operator's labor ($2,569) and interest on his equity in the investment. By comparison, a five-man farm could earn more than $67,000 using 1,720 acres of farmland. Gross income on such a large farm would be $235,000.

During the 1954-59 period, the number of farms in the Texas High Plains with more than 1,000 acres increased by only 5 percent, compared with a 10 percent increase in the number of farms with 500 to 1,000 acres. Farms with less than 500 acres decreased in numbers. The average sized farm family could supply most of the labor for an irrigated cotton farm with 1,040 acres of farmland, including some 331 acres of cotton.

## Drainage

55. Thiel, T. J., and Bornstein, J. TILE DRAINAGE OF A SLOPING FRAGIPAN SOIL. Trans. ASAE 8(4): 555-557. 1965.

An electric resistance analog was used to study the problem of locating tile drains in a sloping fragipan soil. The results of the electrical model study substantiated field data indicating that, for the most part, water generally moves downslope parallel to the soil horizon boundaries. The analog results showed that the influence of subsurface drains on flow direction under the conditions of this study was restricted to the region within about 6 feet on either side of the drain.

An analysis of the hydraulic potentials showed that, when the drain was located in fragipan material, water flowed both above and below the drain and moved on downslope to

the lower drain. However, when the drain was backfilled with $A_{2g}$ soil material it intercepted all downslope flow, and the water divide occurred slightly downslope from the drain.

Although drain outflow was increased about 50 percent by changing the drain depth from 30 to 50 inches, increases of nearly 300 percent were obtained by backfilling the drain with the more permeable $A_{2g}$ soil material.

Additional research should be conducted on the drainage of sloping fragipan soil. The analog results indicated the important role of the hydraulic conductivity of the backfill material. It was concluded that when placing tile drains on a sloping fragipan soil, considerable attention should be given to methods for permanently improving the water-transmitting characteristics of the backfill material over the tile drain.

SWCRD, ARS, USDA, St. Paul, Minn. 55101

56. Johnston, W. R., Letey, J., and Pillsbury, A. F. TILE DRAINAGE PERFORMANCE COMPARED TO THEORETICAL PREDICTIONS. Trans. ASAE 8(4): 548-549, 552. 1965.

Of the four theoretical equations compared in this paper, the van Schilfgaarde equation most accurately predicted a water-table recession rate, especially after the initial 10-day drainage period which started with a saturated soil profile. This equation overestimated the time required for the water table to recede during the first 10 days of drainage, as did the integrated Hooghoudt and the integrated Toksöz and Kirkham equations for the entire drainage period. The Luthin and Worstell equation did a good job of estimating the water-table recession rate during the first 10 days of drainage, but understimated the recession rate for the remainder of the drainage period. Difficulty was encountered in determining hydraulic conductivity and drainable porosity values for use in the equations.

Westlands Water Dist., Fresno, Calif. 93755

57. Bouwer, H. LIMITATION OF THE DUPUIT-FORCHHEIMER ASSUMPTION IN RE-CHARGE AND SEEPAGE. Trans. ASAE 8(4): 512-514. 1965.

The Dupuit-Forchheimer assumption implies unrestricted linearity between flow rate and aquifer thickness. If the latter reaches infinity, this leads to the absurd conditions of zero rise of a recharge mound and of infinite seepage from an open channel that is in contact with the water table. In reality, the relation between flow rate and aquifer thickness for these systems is non-linear and from analyses with a resistance network analog, there appears to be a finite aquifer thickness whereby mound behavior and channel seepage are essentially the same as for infinite thickness of the aquifer. For recharge of unconfined aquifers by surface spreading, this thickness is approximately the same in magnitude as the width or diameter of the percolation zone above the mound. For seepage from a trapezoidal channel with 1 to 1 side slopes, this thickness is reached when the impermeable layer is at a distance of approximately five bottom widths of the channel below the channel bottom. The validity of the D-F assumption must, therefore, be limited to aquifers whose vertical extent is well below these critical values where the mound behavior or seepage losses become essentially immune to further increases in aquifer thickness. If the vertical extent approaches or exceeds these critical values, solutions based on potential flow using mathematical, electric, or physical models are preferable.

Where the vertical extent of the flow system was sufficiently small compared to the effective horizontal extent, however, the D-F assumption yielded reasonable solutions of mound behavior in connection with recharge of groundwater, and of seepage from open channels. The usefulness of the D-F assumption was enhanced if the transmissibility for

the solution of a certain system was obtained from observations of a similar system. This "virtual" transmissibility was essentially a computation factor, which was a property of both the aquifer and the geometry of the flow system.

SWCRD, ARS, USDA, Phoenix, Arix. 85040

58.  van Schilgaarde, J.  LIMITATIONS OF DUPUIT-FORCHHEIMER THEORY IN DRAIN-AGE.  Trans. ASAE 8(4): 515-516, 519.  1965.

A review of the literature was given to show that the D-F theory can be a powerful tool in obtaining acceptable answers to some simple as well as complicated drainage problems but that the user must always be aware of the limitations inherent in the assumptions. If equally simple, less restrictive methods of solution are available--as in steady state drainage--there may be justification for considering the use of these alternatives.
If the limitations are kept clearly in mind, the D-F theory can provide answers that are more than adequate in terms of accuracy. For engineering design, there is little justification in searching for more accurate methods of analysis when the estimation of parameters such as porosity and hydraulic conductivity results in errors far greater than those associated with the thoretical limitations.

SWCRD, ARS, USDA, Beltsville, Md. 20705

59.  Glover, R. E.  APPLICATION OF THE DUPUIT-FORCHHEIMER ASSUMPTIONS IN GROUNDWATER HYDRAULICS.  Trans. ASAE 8(4): 510-512.  1965.

In a study of the application of the Dupuit-Forchheimer assumptions in groundwater hydraulics, the author concluded that the Dupuit-Forchheimer idealization yielded formulas which conformed well with field experience when used with judgment and with a recognition of their limitations. Water quantities were perfectly accounted for while the formulas showed a tendency to strongly determine the quantities of primary interest.

Bur. Reclam., U.S. Dept. Int., Denver. Colo.

60.  Singh, P. B., and Nathan, K.  HYDRAULIC STUDIES OF DRAINAGE DITCHES UNDER TIDAL INFLUENCE.  Trans. ASAE 8(4): 460-463.  1965.

A preliminary report was given on some hydraulic studies of draining ditches under tidal influence in a salt water marsh in New Jersey. The authors concluded that:

1.  Ditching of salt marshes was effective in lowering the water table.

2.  The extent of lowering and its speed were partly dependent upon ditch spacing and soil type.
3.  Field observations on ditches 2-feet deep have indicated that the width of mosquito control lateral drains, in comparison to their spacing, was not greatly significant.
4.  The width of ditches seemed to have no influence on their drainage ability. Wider ditches lasted longer because there was less bank caving and vegetative or floating material clogging.
5.  A large cross-sectional area permitted a greater volume of inflow during flood tide and of outflow during ebb tide. This increased tidal flow may be of minor significance from the standpoint of greater circulation of killifish.

6. In contrast to agricultural drainage, mosquito control drainage required only the elimination of stagnant water on the surface of the marsh as circulation of water was the important factor.
7. The soil of the marsh at Laurence Harbor has a porosity of 83.9 percent. For any area, the necessary fall of the water table within a period of 3 to 5 days can be calculated by adding the average depth of depressions to the quotient of the 12-hour, 10-year frequency rainfall divided by the soil porosity.

Rutgers U., New Brunswick, J.J. 09803

61. Johnson, H. P., and Ligon, J. T. GLASS BEAD-GLYCEROL MODELS FOR STUDY OF UNSTEADY-FLOW DRAINAGE PROBLEMS. Trans. ASAE 8(3): 379-381. 1965.

The glass bead-glycerol model was designed for study of unsteady-flow drainage problems. Dimensional analysis and model design aspects pertinent to the application of the model indicated that all model design criteria can be met, with the exception of those related to capillary forces. These forces were either omitted, where small, or included as a constant, where significant.

The model provides for control of capillary effects during observation of unsteady flow, easy variation of hydraulic conductivity (K) independently of drainable porosity (f), and easy recording of position of the saturated surface. Problems related to pressure on walls and floors during drainage, as well as problems related to field drainage, may be studied through use of the model; the model may be used to observe water-table locations under steady or intermittent rainfall conditions.

The model must be operated in a laboratory provided with temperature and humidity controls. The large glass beads are expensive; the beads must be treated with silicones to control capillary effects.

Data related to tile drainage, ditch drainage, hydraulic pressures on floors, and tile drainage with steady rainfall have been collected.

Iowa State U., Sci. and Tech., Ames, Iowa. 50010

62. Schiff, L. SOIL AND STRATIGRAPHIC CONSIDERATIONS IN A STUDY OF DRAINAGE BY WELLS. Trans. ASAE 8(4): 558-559, 561. 1965.

The feasibility of using wells for drainage was studied in an area in California. This area is intensely farmed and slopes gently northwest. The extent and severity of the saline and/or alkaline conditions have been increasing in portions of the area due to a high water table. The water table is only 1 to 3 feet below the soil surface in many locations in the area.

1. Wells 1 and 2 used in drawdown tests effectively lowered the ground-water table. Well 2 was somewhat less effective than well 1 for a radius approaching one-half mile because of seepage from a nearby canal. Well 3 did not effectively lower the ground-water table because of the seepage of water from a nearby canal.
2. Wells for drainage appear feasible in this area providing they are located where soils and stratigraphy are favorable and seepage is not a problem.
3. Careful location of drainage wells also considers seepage from canals or ditches. Seepage occurs in locations where the soil has a medium to high hydraulic conductivity. Effective drawdown by wells is thus prevented. Generally drainage wells should not be placed near canals from which water seeps appreciably unless such canals are treated or lined to reduce seepage.

Wells in the southern portion of the area would relieve some of the seepage toward the area from upslope lands. This would make the wells within the area somewhat more effective. However, the hydraulic gradient into the area is low, and the small amount of seepage into the area does not appear to warrant interception.

SWCRD, ARS, USDA, Fresno, Calif. 93726

63. Fang, L. HOW TO SELECT A DRAINAGE PUMP. Agr. Engin. 46(11): 630-632, 635. $0.50. Nov. 1965.

Basic hydraulic principles and inherent pump characteristics were used to explain a new approach for the selection of drainage pumps.

For Sale ASAE, 420 Main St., St. Joseph, Mich. 49085

64. Hermsmeier, L. F. DRAINAGE CHARACTERISTICS OF FARGO-BEARDEN SOILS. Trans. ASAE 8(3): 371-373, 376. 1965.

In a study of the drainage characteristics of Fargo-Bearden soils in Minnesota, the authors concluded that:

1. The water table in Fargo-Bearden soils rose to within 1 foot of the surface during and following spring runoff and then dropped at a rate of 3/4 to 2-1/2 inches per day to a depth of 6 to 10 feet by the end of the year, unless interrupted by excessive rains.
2. Hydraulic conductivity as determined by the core method was from 5 to 17 times greater for soils under bromegrass than under soybeans or corn. This difference was observed for depths to 3 feet.
3. These soils contained from 50 to 80 percent clay and from 2 to 20 percent silt at depths to 5 feet.
4. These soils held about 15 inches of available water in a 5-foot depth.
5. Bulk density was not correlated with hydraulic conductivity.
6. Water usually moved downward in these soils. The permanent water table was usually below the 5-foot depth.
7. Tile lines significantly lowered the water tables for short periods of several days following spring runoff and heavy rains. However, soybean yields were not increased as a result of tiling.
8. Soil freezing had a significant effect on drainage. Beginning in December, the soil froze from the surface downward at a rate of about 1-1/2 to 2 feet per month and reached a maximum depth of 4 to 6 feet about the middle of March. The maximum depth of freezing was from 1 to 1-1/2 feet greater where there was little or no protective surface cover (fallow or soybean stubble) as compared to that where there was a cover of bromegrass or alfalfa. The soil thawed mostly from the surface downward, beginning about the middle of March, and the last frost left the soil between mid-April and mid-May.
9. Except for small localized areas, these soils did not contain sufficient exchangeable sodium or soluble salts to adversely affect crop growth.

SWCRD, ARS, USDA, Morris, Minn. 56267

65. Faulkner, M. C. LEVELING RICE LAND IN WATER. Trans. ASAE 8(4): 517-519. 1965.

Leveling rice land is used for better irrigation water management and adequate drainage. Leveling in water has the advantage over dry leveling (land forming) of allowing a farm operator to use equipment commonly found on a rice farm, to use water wave action to help keep top soil in place, and to move lower, more compact soil. The equipment required to level rice land in water is a tractor of 50 draw bar hp. or greater and an implement with a vertically adjustable blade, similar to one on a model 329 Eversman leveler. Relatively large tractors, commonly used in rice farming, are required in order to create a wave of water that will help move and smooth the soil.

By leveling (forming) rice land as much as 80 percent of the levees were removed with adequate slope maintained for drainage. Leveling in water to remove levees and create a uniform slope is essentially bench leveling. The time required for the operation depended on topographic conditions and operator experience and varied from 2 to 4 hours per acre.

Pumping time on some farms was reduced by as much as 50 percent after leveling. Some farmers reported yield increases as high as 1,000 pounds of rice per acre over their highest previous yields.

Estimates were made that over 25 percent, or well over 100,000 acres, of Louisiana rice land has been leveled using this method. Under certain soil conditions, it may not be possible to level land in water.

Rice Expt. Sta., La. State U., Crowley, La. 70526

## Evaluation of Flood Water Damage

See 1, 9, 22.

## Storage and Conveyance

See Also 25, 28, 34, 57, 157, 232.

66. Beauchamp, K. H. STORAGE PONDS AS A SOURCE OF IRRIGATION WATER. Sprinkler Irrig. Assoc. Proc. 1965: 49-60. 1965.

A detailed report was given on the construction and use of storage ponds as a source of irrigation water. The following types of storage were discussed: Runoff storage reservoirs; seepage storage reservoirs; off-stream storage; and regulating storage.

The need and use of reservoir sealants were given.

SCS, USDA, Lincoln, Nebr.

67. Ray, E. E. THE EFFECTS OF SMALL FLOODWATER RETARDING STRUCTURES ON INFREQUENT FLOODS. Agr. Engin. 46(3): 150-152. $0.50. 1965.

A report was given on the plan and evaluation of 20 small floodwater retarding structures proposed for construction on Upper Crooked Creek and tributaries in Boone County, Ark.

Reductions in peak flow decreased somewhat downstream from the dam sites, but the structures reduced Harrison urban damages about 90 percent for the flood of record, an estimated 115-year frequency event, and resulted in a 90-percent reduction in average annual watershed damages.

Reductions in peak flows and stages due to upstream structures alone, or from structures in combination with levees and/or channel improvement, were of sufficient magnitude to meet desirable and economical project objectives in both urban and agricultural damage areas.

Small structures can control large floods, but each watershed must be considered independently and the degree of control justified on the basis of need.

For sale, ASAE, 420 Main St., St. Joseph, Mich. 49085

68. Holeman, J. N. SEDIMENTATION OF LOCH RAVEN AND PRETTYBOY RESERVOIRS, BALTIMORE COUNTY, MD. U.S. Dept. Agr., Soil Conserv. Serv. SCS-TP-145, 18 pp. 1965.

Information obtained from the 1961 sedimentation surveys of Loch Raven and Prettyboy Reservoirs in Baltimore County, Md., was reported. It appeared that erosion had been reduced 56 percent in Prettyboy Watershed and 70 percent in Loch Raven Watershed by using the land within its capability and by following recommended conservation practices. Because of these changes, there has been a tremendous reduction in sediment damage to the two reservoirs, and the effective life has been greatly extended.

The sediment yield of a watershed can be reduced to tolerable limits by applying approved conservation measures and by using the land within its capability. Keeping the soil in place not only maintains and enhances soil productivity but is also the most economical way to reduce sediment damage downstream.

Inform. Div., SCS, USDA, Washington, D.C. 20250

69. Shanholtz, V. O., and Holtan, H. N. COMPUTER PROGRAM USHL NO. 2: WATER SURFACE PROFILES FOR SPATIALLY VARIED FLOW IN NATURAL CHANNELS. U.S. Dept. Agr., Agr. Res. Serv. ARS 41-101, 38 pp. 1965.

A program for computing water surface profiles by the step method was modified to spatially vary flow concordantly with drainage area to provide the profiles for selected flows-per-unit-area. The program was further modified to interpolate hydraulic elements for theoretical cross sections at predetermined vertical intervals. Spatial variation of flow was also graduated by interpolating flow between cross sections in the ratio of the accumulative interval of elevation. By these means, the water surface profiles were stabilized in close conformity with profiles computed by more sophisticated techniques.

Inform. Div., SCS, USDA, Washington, D.C. 20250

70. Wilson, T. V., and Snell, A. W. SEEPAGE CONTROL IN FARM PONDS. S.C. Agr. Expt. Sta. C. 141, 12 pp. 1965.

When farm ponds in the Piedmont, Sandhills, and upper Coastal Plains regions leak excessively, any attempt to eliminate or reduce seepage adds extra cost. The amount of extra capital outlay which can be justified depends upon the value the owner places on the pond.

Four methods of seepage loss reduction were discussed. They were: (1) Lining the pond with a plastic film; (2) putting a plastic core in the dam; (3) thoroughly pulverizing and packing the soil in the pond floor; and (4) adding commercially available kaolinite or suitable natural "B" horizon soil to the pond floor, followed by thorough mixing and compaction.

There are situations in which each of the four methods can be effective and economically justified.

S.C. Agr. Expt. Sta., Clemson U., Clemson, S.C. 29631

71. Soil and Water Conservation Research Division. PROCEEDINGS SEEPAGE SYMPOSIUM PHOENIX, ARIZONA, FEBRUARY 19-21, 1963. U.S. Dept. Agr., Agr. Res. Serv. ARS-41-90, 180 pp. 1965.

The following papers and their discussion were given that were presented at the Seepage Symposium at Phoenix, Ariz., Feb. 19-21, 1963.

72. Coyle, J. J. FARM SEEPAGE PROBLEMS IN PONDS AND SMALL IRRIGATION RESERVOIRS.

73. Vandertulip, J. J., McDaniels, L. L., and Walker, G. D. SEEPAGE LOSSES FROM NATURAL CHANNELS USED AS MAJOR CONVEYANCE FACILITIES.

74. Shipley, H. SEEPAGE PROBLEMS IN THE JET AGE.

75. Sutton, J. G. DAMAGE TO LANDS BY SEEPAGE.

76. Welker, C. H. SEEPAGE PROBLEMS IN WEST PAKISTAN.

77. Wineland, J. A., and Lucas, C. V. ECONOMIC COMPARISONS OF CANAL LININGS FOR THE CALIFORNIA AQUEDUCT.

78. Nielsen, D. R. PERCOLATION OF WATER IN SOIL.

79. Bouwer, H. THEORY OF SEEPAGE FLOW SYSTEMS.

80. Shaw, W. B. RESISTIVITY AND PHOTOGRAPHIC TECHNIQUES FOR SEEPAGE EVALUATION.

81. Reisenauer, A. E., and Nelson, R. W. SOME INFLUENCES OF SOILS AND WATER TABLE DEPTHS ON SEEPAGE FROM LINED AND UNLINED CANALS.

82. Bower, C. A. EFFECT OF WATER QUALITY ON SEEPAGE THROUGH SOIL.

83. Bouwer, H. APPLICATION OF SEEPAGE METERS.

84. Hanson, E. G. INFLUENCE OF DITCH LININGS ON SEEPAGE LOSSES FROM FARM DITCHES IN SOUTHWESTERN NEW MEXICO.

85. Willson, R. J. A LOWER COST CANAL LINING PROGRAM.

86. Lauritzen, C. W. CONVEYANCE LOSSES IN IRRIGATION SYSTEMS AND MEASURES FOR CONTROL.

87. Dirmeyer, R. D., Jr., and Skinner, M. M. SEEPAGE REDUCTION WITH COLORADO CLAYS.

88. Wilder, C. R. CONCRETE CANAL LININGS FOR CONTROL OF SEEPAGE.

89.  Decker, R. S. SEALING SMALL RESERVOIRS WITH CHEMICAL SOIL DISPERSANTS.

90.  Warnick, C. C. PROBLEMS IN SEEPAGE EVALUATION AND CONTROL.

91.  Dybalski, J. N. CATIONIC CHEMISTRY IN WATER CONSERVATION.

92.  Glenn, J. H. A POLYMER COMPOUND FOR SEEPAGE REDUCTION.

93.  Rundle, V. A., Watson, C. E., and Chapdelaine, P. L. METHODS FOR APPLYING
     WATERBORNE PETROLEUM SOIL SEALANTS.

94.  Fefer, M., and Condon, J. R. SEEPAGE CONTROL USING BUTYL RUBBER LATEX.

95.  Hart, F. C. EXPERIENCE WITH SEEPAGE CONTROL IN THE PACIFIC NORTHWEST.

Publication Editor, SWCRD, ARS, USDA, Beltsville, Md. 20705

96.  Myers, L. E. HARVESTING PRECIPITATION. Internatl. Assoc. Sci. Hydrol. P. 65:
     343-351. 1965.

New water supplies can be developed by harvesting precipitation which is now lost to
nonbeneficial evapotranspiration. Precipitation harvesting is an ancient practice, utilized
over 4,000 years ago in the Negev Desert. The major deterrent to present use is the high
cost of durable structures for collecting and storing rainfall and snowmelt. Costs are
being reduced by research and development aimed specifically at the performance require-
ments for precipitation harvesting structures.

Current research indicates that treatments can be developed to water-proof and
stabilize soil surfaces for 2 cents per square meter. Such a treatment can collect water
in a 200 mm. rainfall zone for 10 cents per 1,000 liters. Storage costs can be greatly re-
duced by new concepts and material for new construction and by building harvesting areas
about existing reservoirs or groundwater recharge areas. Precipitation harvesting can be
competitive with other water supply methods in many areas, and there are many locations
where it offers the only opportunity to develop new water supplies.

SWCRD, ARS, USDA, Tempe, Ariz. 85281

# BASIC SOIL SCIENCE

## Soil Physics

See Also 16, 33, 44, 56, 57, 64, 78, 96, 132, 148, 158, 166, 168, 169, 171, 173, 175, 189, 195,
199, 200, 209.

97.  Kemper, W. D., and Koch, E. J. AGGREGATE STABILITY OF SOILS FROM WESTERN
     UNITED STATES AND CANADA: MEASUREMENT PROCEDURE; CORRELATIONS
     WITH SOIL CONSTITUENTS. U.S. Dept. Agr., Agr. Res. Serv. Tech. B. 1355, 52 pp.
     1965.

The place of aggregate stability in the soil structure--crop yield picture was dia-
grammed. Soil constituents were major factors influencing aggregate stability which, when
acted upon by traffic, cultivation, weather, and irrigation, determined the soil structure.

The following factors involved in the determination of aggregate stability by wet sieving were evaluated: (1) Moisture content at sampling time; (2) tools used for sampling; (3) temperatures at which samples were dried; (4) humidity during storage; (5) length of storage time; (6) temperature during storage; (7) size of aggregates used; (8) methods of wetting the sample; (9) period of soaking prior to wet sieving; (10) temperature of water in which samples were wetted and sieved; (11) sieve and sample size; (12) sieve stroke length and frequency; and (13) length of sieving time. On the basis of these evaluations, a standardized procedure was proposed to yield meaningful and reproducible results with subhumid, semi-arid, and arid region soils, and yet require only a moderate amount of time and equipment.

The proposed method was used to evaluate the aggregate stability of over 500 samples from Western United States and Western Canada. These aggregate stabilities were then correlated in a multiple regression equation with measured values of organic matter, clay, free iron oxide, and exchangeable sodium.

The constituent variables--free $Fe_2O_3$, clay, organic matter, and exchangeable sodium--were all shown to be causative agents in stabilizing or destroying soil aggregates. In general, organic matter in excess of 2 percent added little to aggregate stability, but reduction of organic matter to values less than 1 percent caused a rapid decrease in aggregate stability.

Inform. Div., ARS, USDA, FCB, Hyattsville, Md. 20782

98. Tamhane, R. V., and Datta, N. R. WATER-STABLE AGGREGATES IN RELATION TO PHYSICAL CONSTANTS OF SOILS. J. Indian Soc. Soil Sci. 13(3): 205-210. Sept. 1965.

Both in the surface and subsoil, the water-stable aggregates were significantly related to: The moisture equivalent; moisture holding capacity; clay, silt, and clay; clay ratio; plasticity index; and loss on ignition. The relationships were highly significant in the case of loss on ignition and clay ratio. A multiple regression equation was given for subsoil involving water-stable aggregates (percent) in relation to physical constants of the soil--loss on ignition and clay ratio. Stability index for water-stable aggregates was obtained on dividing clay ratio by loss on ignition. The stability index was found to be inversely related to the amounts of water-stable aggregates with diameter greater than 0.2 mm.

Indian Agr. Res. Inst., Delhi, India.

99. Pallas, J. E., Jr., Bertrand, A. R., Harris, D. G., Elkins, C. B., Jr., and Parks, C. L. RESEARCH IN PLANT TRANSPIRATION: 1962. U.S. Dept. Agr., Agr. Res. Serv. Prod. Res. Rpt. 87, 56 pp. 1965.

Experiments were conducted to measure plant transpiration in a controlled environment growth room. Radiant energy, relative humidity, and soil moisture tension had marked effects on the transpiration rate. Guard cell operation was measurably affected by moisture availability. Osmotic pressure determinations made concurrently with stomatal observations showed that, with the species studied, operation of stomata could not be correlated with changes in osmotic pressure of the guard cells.

Tests were made of several formulations applied to leaves to provide either a physical barrier to transpiration or a potential control of stomatal operation. Materials included latex and plastic compounds, waxes, mercury and fluoride compounds, and $\alpha$-hydroxysulfonates. Although a number of these formulations reduced transpiration, few did so without also depressing plant growth. In experiments with the most effective transpiration suppressants, treated leaves developed a temperature differential of $6^{\circ}$ to $10^{\circ}$ C. over that of untreated leaves.

Inform Div., ARS, USDA, FCB, Hyattsville, Md. 20782

100. Pallas, J. E., Jr. TRANSPIRATION AND STOMATAL OPENING WITH CHANGES IN
    CARBON DIOXIDE CONTENT OF THE AIR. Sci. 147(3654): 171-173. Jan. 8,
    1965.

   Increasing the carbon dioxide content of air reduced the transpiration rate of corn
and sorghum plants and, to a lesser extent, of cotton, soybean, and tomato plants by
causing the stomata to close. Closure of corn and sorghum stomata occurred when the
concentrations of carbon dioxide were 2,000 and 3,000 p.p.m., respectively. Cotton, soy-
bean, and tomato stomata did not close completely at concentrations of carbon dioxide up
to 4,000 p.p.m.

SWCRD, ARS, USDA, Watkinsville, Ga. 30677

101. Fowler, W. B. THE ENERGY BUDGET AND ITS USE IN ESTIMATING EVAPO-
    TRANSPIRATION. Proc. Soc. Amer. Foresters, Denver, Col. 1964: 101-104. 1964.

   A sufficient amount of information is now available regarding the nature of the energy
budget. There are a number of simple estimation procedures for both potential and actual
evapotranspiration (ET), permitting routine analysis of this basic climatological factor.
Interest in the energy budget as a basic tool may be expected to continue along with modi-
fication and improvement of estimation procedures based on it.
   Graphical methods such as those presented would appear to be the most feasible
approach at this time; additional basic knowledge regarding the overall energy budget and
the variation of partition ratio with time under natural conditions should permit determi-
nation of a number of fundamental mathematical models covering a variety of situations.
   Extension of radiation climatologies is necessary for improvement of overall accu-
racy for any estimation procedure based on the energy budget.
   Procedures for estimating actual ET cannot be expected to provide more than a
reasonable approximation of short-term moisture loss but can prove invaluable where no
other information is available. Those for estimating potential ET are generally more
reliable, even when based on a single energy input parameter.

Pacific Northwest Forest and Range Expt. Sta., FS, USDA, Portland, Oreg. 97208

102. Dylla, A. S., and Muckel, D. C. IMPORTANCE OF MEASURING SOIL MOISTURE
    CHANGES IN NONWEIGHING EVAPOTRANSPIRATION TANKS. Trans. ASAE
    365-366. 1956.

   Plastic membrane evapotranspiration tanks were installed at Winnemucca, Nev., for
determining quantities of water consumed by native meadow grasses. The grasses were
established in the tanks with constant 4-foot depth water table aided by surface irrigation
during 1960-1961. A neutron depth moisture probe was used to monitor soil moisture
conditions within the tanks during the 1962 season, while the water-table depth was held
constant.
   Determination of the soil-profile moisture content indicated changes in soil moisture
occurred during the growing season. Such changes were characterized by a "drying" or
narrowing of the capillary fringe during periods of maximum plant growth and water use,
and by a capillary wetting or an increasing of soil moisture above the water table follow-
ing hay harvest with consequent declining rate of water consumption. The greater soil
moisture changes occurred in tanks producing the heavier hay yields and consuming the
greater amounts of water. It was shown that neglect to account for soil moisture changes
in nonweighing evapotranspiration tanks could result in erroneous consumptive-use rates

calculated for short periods. Calculated seasonal consumptive-use rates may be reasonably accurate since soil moisture content tends to be equal at the beginning and the end of the growing season.

SWCRD, ARS, USDA, Reno, Nev. 89507

103. Dreibelbis, F. R. USE OF THE NUCLEAR PROBE IN STUDIES OF THE SOIL MOISTURE REGIMEN ON LYSIMETERS AND SMALL WATERSHEDS. In INTERNATIONAL SYMPOSIUM ON HUMIDITY AND MOISTURE, WASHINGTON, D.C. 1963. HUMIDITY AND MOISTURE. 2:106-115. 1965.

Resistance blocks and neutron scattering equipment were used to obtain soil moisture data on watersheds 0.5 to 0.9 hectare and on monolith lysimeters 8.09 square meters in area. Measurements were made in 1.8-meter profiles of two soil types under corn, wheat, meadow, and woodland covers. The reliability of the probe and blocks was confirmed by comparing data obtained from these with data from the weighing lysimeter. Likewise, ET as determined from weight changes checked closely with ET data obtained from the probe and blocks.

Soil type showed little influence in the 0-18 centimeter layer, the zone of major hydrologic activity, but exerted considerable influence in the lower soil layers. Agronomic practice influenced the moisture regimen more than did soil type. The contrast between different crops also had a marked effect.

The possibility of extrapolating these small-area results to the field of watershed management was discussed.

SWCRD, ARS, USDA, (Retired) 614 Highland Blvd., Coshocton, Ohio. 43812

104. Marston, R.B. CHECKING THE CALIBRATION OF NUCLEAR SOIL MOISTURE AND DENSITY MEASURING EQUIPMENT. U.S. Forest Serv. Res. Note CS-31, 4 pp. March 1965.

Users of soil moisture and density measuring nuclear probes should check the general operation of their equipment by making a "standard" or "shield" reading several times during each day of use. In short-term studies they can easily and quickly made additional calibration curve check readings with the probes suspended in air and on or under water. If such nuclear equipment is to be used in long-term studies, however, a group of standard checks should be assembled to facilitate more intensive checking to detect changes or drift in the calibration curves.

Sand, alum, and mixtures of sand and alum make satisfactory checks for moisture measuring nuclear probes.

Road-bed gravel, calcined clay, air-dry clay, and polyurethane foam may be used in separate drums to supplement the all-sand and all-alum drums so as to produce a wide enough range of densities for checking density probes.

Checks should be prepared so that both surface and subsurface probes can be checked on them. This can be done by inserting the access tube for the subsurface probes through the side of the container leaving the top surface free.

North Central Expt. Sta., FS, USDA, St. Paul Campus, U. Minn., St. Paul, Minn. 55101

105. Miller, R. J., Biggar, J. W., and Nielsen, D. R. CHLORIDE DISPLACEMENT IN PANOCHE CLAY LOAM IN RELATION TO WATER MOVEMENT AND DISTRIBUTION. Water Resources Res. 1(1): 63-73. 1965.

The manner in which chloride, applied to the soil surface as KCl, moves through Panoche clay loam was investigated under field conditions. Three soil water treatments were established: (1) Continuous ponding; (2) intermittent ponding with 6 inches of water; and (3) intermittent ponding with 2 inches of water. Frequent measurements of the chloride concentration in the soil solution at 1-foot depth intervals to a depth of 5 feet were used to ascertain the redistribution of the surface-applied chloride relative to the movement of soil water. Chloride movement resulted from a dynamic process that was altered or controlled with the method of water application.

U. Calif., Davis, Calif. 92502

106. Gray, D. M., and Mahapatra, A. K. A METHOD OF MEASUREMENT OF THE GROUND WATER TABLE AND SOIL HYDRAULIC CONDUCTIVITY. Canad. Agr. Engin 7(1): 25-27, 36. Jan. 1965.

Details concerning the design and operation of an instrument for determing the position of the ground water table and the hydraulic conductivity of a soil were presented. The probe, which consists of a series of small cups mounted vertically one over the other, was used in a piezometer installation. The water table position and hydraulic conductivity of the soil were calculable from observations of the times required to fill the cups under different constant heads.

Investigations were conducted with the probe in the field in two soils of widely different hydraulic conductivities. For each soil, the position of the water table as calculated from the probe readings compared very closely with measured depths.

It was anticipated that the probe will find wide usage in drainage and water table investigations, particularly in heavy soils, because the water table position can be calculated without having true static conditions.

U. Saskatchewan, Saskatoon, Saskatchewan, Canada.

107. Jackson, R. D., Reginato, R. J., and Van Bavel, C. H. M. COMPARISON OF MEASURED AND CALCULATED HYDRAULIC CONDUCTIVITIES OF UNSATURATED SOILS. Water Resources Res. 1(3): 375-380. 1965.

Three methods used to calculate the unsaturated conductivity of soil from its moisture characteristic were tested. Calculated values were compared with direct measurements of conductivity for both sorption and desorption for a sand. Also, comparisons were made for three soil materials. The method of calculation proposed by Millington and Quirk in 1959, when matched at the saturated conductivity, gave good results.

SWCRD, ARS, USDA, Phoenix, Ariz. 85040

108. MILLER, D. E. STORE 50 PERCENT MORE WATER IN LAYERED SOIL. Agr. Res. 13(7): 7. 1965.

A uniform soil above a layer of coarse sand or gravel holds about 50 to 60 percent more available water than similar soil of the same depth without such a layer.

The soils of many irrigated areas of the West are layered because they were deposited by flowing water that carried sand or gravel--or because they were deposited on top of coarse water-lain materials. The coarse-textured material increases the efficient use of irrigation water by limiting moisture loss through deep percolation in these soils.

Moisture held in the soil is under suction or tension; the smaller the amount of water, the greater the suction. The coarse layers contain mostly large pores that drain readily after the soil has been wetted, while the smaller pores in the overlying soil remain water filled. Because of the many empty pores in the coarse layer, resistance to water movement through the layer becomes so great that water cannot drain out of the soil layer above. It is thus available for plant use.

Usual procedures for measuring or predicting the water-holding capacity of irrigated soils may seriously underestimate moisture storage in layered soils. Available moisture measured in the field was 130 percent greater than the laboratory estimate for Ephrata and Timmerman soils and 104 percent greater than the laboratory estimate for Rupert soil.

Field determinations in stratified soils can be in error if precautions are not taken to prevent lateral movement of water from the point of measurement. In the process of minimizing deep percolation, the coarse layer tends to cause water movement across the top of the layer. Where lateral flow was permitted, the available water measured at a depth of 6 to 12 inches in Ephrata and Scooteney soils was only 60 percent as much as that recorded where lateral flow was prevented.

SWCRD, ARS, USDA, Prosser, Wash. 99350

109. Liakopoulos, A. C. VARIATION OF THE PERMEABILITY TENSOR ELLIPSOID IN HOMOGENEOUS ANISOTROPIC SOILS. Water Resources Res. 1(1): 135-141. 1965.

The flow of water through a homogeneous anisotropic soil is governed by Darcy's equation in which the velocity is proportional to the imposed hydraulic gradient. The constant of proportionality (coefficient of permeability) is a symmetric tensor of second rank, reducing to a scalar only in the case of isotropic soils. For determining the velocity vector from a known hydraulic gradient, the permeability tensor ellipsoid should be constructed with semiaxes equal to the inverse of the square root of the permeability values. For determining the hydraulic gradient from a known velocity, the permeability tensor ellipsoid should have semiaxes equal to the square root of the principal permeability values.

The fact that two different tensor ellipsoids can be constructed for a given anisotropic soil may produce confusion and give rise to a significant error. Special attention should be given in evaluating the appropriate permeability value to be used in Darcy's equation. It was recommended that the ellipsoid used always be the one with semiaxes equal to the inverse square root of the principal permeability values.

Permeability tests were conducted on anisotropic sandstone. Cylindrical cores were taken at various directions with respect to a fixed coordinate system, and permeability values were determined in a constant-head permeameter. The values obtained when plotted on polar coordinate paper resulted in a two-dimensional permeability ellipse. The necessary graphical constructions for determining the direction of the hydraulic gradient from the corresponding tensor ellipses were given.

Col. Engin., Riyadh, Saudi Arabia.

110. Bartlett, R. J. A BIOLOGICAL METHOD FOR STUDYING AERATION STATUS OF SOIL IN SITU. Soil Sci. 100(6): 403-408. Dec. 1965.

A quantity concept, "aeration status," was proposed as being more useful than oxidation-reduction potential for comparing oxidizing or reducing characteristics of field soils. It was suggested that nitrogen transformations occurring in a soil should provide a

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practical characterization of aeration status. A method involving samples of standard soil confined in thin polyethylene was tested. The samples were analyzed for nitrate and ammonium following equilibration with the soil to be characterized.

Month-long equilibration and leaching studies showed permeability of polyethylene to inorganic ions to be measurable but inconsequential in terms of percentages of the total amounts present. Movement of water vapor through the film was not large enough at low gradients to be of concern.

Comparison of nitrate losses and carbon dioxide evolution during incubation of enclosed versus freely ventilated soil gave no indication that diffusion of oxygen through the polyethylene was limiting rapid biological activity.

In a laboratory study, differences in aeration status between bulk soils containing moisture at 1, 1/3, 1/10, and 0 atmospheres of tension were reflected in the nitrate contents of the standard confined buried samples. In field soils, relative aeration status, as deduced from changes in nitrate and ammonium in buried samples, correlated with the natural drainage classification (U.S. Dept. of Agr. Handbook 18) of the five sites studied.

High ammonium contents of the confined soils were associated with almost complete disappearance of nitrate and the presence of reduced or recently oxidized iron.

The technique of burying standard soil samples in polyethylene bags showed promise as a practical means for comparing the aeration statuses of soils in situ. It eliminated leaching and much of the sampling error usually inherent in studies involving comparative analyses of field soils.

U. Vt., Vt. Agr. Expt. Sta., Burlington, Vt. 05401

111. Rickman, R. W., Letey, J., and Stolzy, L. H. SOIL COMPACTION EFFECTS ON OXYGEN DIFFUSION RATES AND PLANT GROWTH. Calif. Agr. 19(3): 4-7. March 1965.

Aeration conditions, as measured by the platinum microelectrode technique, were less favorable in compacted soil layers than conditions known to limit root growth in noncompacted soil. However, reduced root penetration and top growth of tomatoes grown above these compacted layers could not be blamed upon either the high physical resistance to root penetration or poor aeration, individually, because both factors were simultaneously present in the compacted soil layers.

Jr. Author, U. Calif., Riverside, Calif. 92502

## Soil Chemistry and Mineralogy

See Also 105, 121-125, 127, 129, 131, 140, 141, 165, 172-175, 178, 185, 197, 203, 209.

112. Singh, S. S., and Turner, R. C. SULPHATE IONS AND CATION EXCHANGE REACTIONS WITH CLAYS. Canad. J. Soil Sci. 45(3): 271-279. Oct. 1965.

The effect of replacing $NO_3^-$ with $SO_4^{2-}$ in solution on exchange between $Al^{3+}$ or $Fe^{3+}$ and $Ca^{2+}$ was investigated for aqueous acid clay systems. If the activities of the cations in solutions were not corrected for soluble cation-$SO_4^{2-}$ complexes, the results with $SO_4^{2-}$ were definitely different from those with $NO_3^-$. When the corrections for complexing were made, there was little if any difference between the results with the two anions, as far as exchange reactions and the relation between adjusted lime potential and degree of Ca saturation of clays were concerned. The presence of $SO_4^{2-}$, however, had a marked effect on the ion product $(Fe)(OH)^3$ but not on $(Al)(OH)^3$ in solution.

Soil Res. Inst., Canada Dept. Agr., Ottawa, Ontario, Canada.

113. Jackson, P. C., and Stief, K. J. EQUILIBRIUM AND ION EXCHANGE CHARAC-
     TERISTICS OF POTASSIUM AND SODIUM ACCUMULATION BY BARLEY ROOTS.
     J. Gen. Physiol. 48(4): 601-616. 1965.

Potassium ion and $Na^+$ influx rates into and from excised barley roots were com-
pared with the maximum capacity of accumulation. Potassium ion and $Na^+$ influx and
efflux involved a cation exchange that was independent of simultaneous exchange of the
accompanying anion. These exchange fluxes depended on the concentration and cation
composition of the solutions from which they originated. Selective differences between
$K^+$ and $Na^+$ fluxes were sufficient to account for a cationic distribution within the roots
that differed markedly from that of the external solution and that persisted for extended
time periods. The accumulation maximum was a cation exchange equilibrium with the
cation influx and efflux rates approaching equality. The equilibrium level was independent
of the individual cation fluxes and the external solution concentration. It was a finite
quantity which appeared to be determined by the internal anion concentration including
accumulated as well as endogenous anions.

SWCRD, ARS, USDA, Beltsville, Md. 20705

114. International Atomic Energy Agency. ISOTOPES AND RADIATION IN SOIL-PLANT
     NUTRITION STUDIES. Internatl. Atomic Energy Agency Proc. Ser. STI/PUB/
     108, 609 pp. $12.00. 1966.

The application of radioisotopes to studies of soil fertility and plant nutrition is
yielding valuable information on improved methods of crop production. Experiments with
radioisotopes have provided a better knowledge of the movement and availability of plant
nutrients and water in the soil. This knowledge is leading to the development of improved
methods of application, timing, and placement of fertilizers which will result in greater
efficiency in their use. The complete proceedings were given of a joint International
Atomic Energy Agency and Food and Agricultural Organization of the United Nations
symposium on the subject held in Ankara June-July 1965. The 45 papers were published
in their original languages with summaries in English, French, Russian, and Spanish. The
discussion was in English.
    Among the topics discussed were: Soil chemistry of inorganic ions; soil organic
matter; the measurement and movement of soil water; ion uptake and translocation; and
the reactions and interactions of fertilizer nutrients in soils and their distribution and
use by plants.

For sale, Internatl. Atomic Energy Agency, Natl. Agency for Internatl. Pub., Inc., 317 E.
34th St., New York, N.Y. 10016

115. Akin, G. W., and Lagerwerff, J. V. CALCIUM CARBONATE EQUILIBRIA IN SOLU-
     TIONS OPEN TO THE AIR. II. ENHANCED SOLUBILITY OF $CaCO_3$ IN THE
     PRESENCE OF $Mg^{2+}$ AND $SO_4^{2-}$. Geochimica et Cosmochimica Acta. 29: 353-
     360. 1965.

The solubility of $CaCO_3$ was determined in natural waters and in synthetic solutions
containing $Mg^{2+}$ or $SO_4^{2-}$ near $25^O$ C., and at partial pressures of $CO_2$ in the range
normal for the atmosphere. Solubility enhancement relative to the theoretical solubility of
calcite was encountered in all the waters and solutions studied. A theory was developed
on the basis of Langmuir adsorption of $Mg^{2+}$, $SO_4^{2-}$, and the ions of $CaCO_3$ on a crystal
surface consisting of calcite and of $CaCO_3$ having a modified calcite lattice. Both types of

surface are in intimate contact through surface flow of adsorbed ions. From the theory, an equation was derived relating the activity product $(Ca^{2+})(CO_3^{2-})$ to the concentration ratios $[Mg^{2+}] / [Ca^{2+}]$ and $[SO_4^{2-}] / [CO_3^{2-}]$ at equilibrium. The equation was fitted to solubility data on the synthetic solutions. Parameters thus evaluated separately for the effect of $Mg^{2+}$ and of $SO_4^{2-}$ were used together in the equation to calculate solubilities in six natural waters of widely different compositions. Good agreement was obtained with measured solubilities.

SWCRD, ARS, USDA, Beltsville, Md. 20705

116. Nelson, C. E., Early, R. E., and Mortensen, A. NITROGEN FERTILIZATION OF CORN IN RELATION TO SOIL NITRATE NITROGEN. Wash. Agr. Expt. Sta., Sta. C. 453, 9 pp. 1965.

Calcium nitrate at 0, 40, 80, 120, 160, 320 lb. N/acre was applied broadcast as main plots 10.7 feet wide x 160 feet long with four replicates on wheat land. This was plowed under and irrigated three times before seeding field corn on May 8. Each main plot was divided into 4 subplots.

After the corn emerged, each subplot was soil sampled at nine locations in a specific pattern in relation to the irrigation rills. The depth-samples were composited for nitrate nitrogen analysis.

The corn in the subplots in each main plot was sidedressed with 0, 40, 80, or 120 lb. N/acre June 6.

The corn yields increased with increasing amounts of soil nitrate nitrogen plus fertilizer nitrogen, reaching a maximum at about 160 bu./acre at 280 lb. N/acre. Additional N did not increase yields beyond this point.

The regression of yields on soil nitrate plus fertilizer nitrogen was computed from the data within the nitrogen-yield response range. It was inferred that about 2 lb. of soil nitrate plus fertilizer nitrogen was needed to increase corn yields 1 bu./acre.

The data showed that the nitrogen fertilizer needs for a given corn yield could be calculated from soil nitrate determinations.

The nitrifiable nitrogen in the soil during the growing season must be estimated. This value, which is the intercept of the regression line on the yield axis, may be higher or lower than that given in the text, depending on the kind and amount of organic matter in the soil.

Wash. Agr. Expt. Sta., Col. Agr., Wash. State U., Pullman, Wash. 99163

117. Wagner, G. H. CHANGES IN NITRATE N IN FIELD PLOT PROFILES AS MEASURED BY THE POROUS CUP TECHNIQUE. Soil Sci. 100(6): 397-402. Dec. 1965.

Field plots liberally fertilized with ammonium nitrate and without nitrogen treatment were established to estimate leaching and crop recovery of nitrogen. Leaching was estimated by the porous ceramic cup technique designed to sample internal drainage waters within the profile. Water samples collected periodically during 4 years indicated that a significant amount of nitrate-nitrogen had leached through the subsoil. Higher nitrate concentrations occurred in samples taken at depths of 3 and 4 feet during the first 2 years, but nitrate concentration at these depths decreased thereafter. Total nitrate in the measured profile decreased with time, and after 3 successive years of cropping to sudan grass it was as low in fertilized plots as in control plots.

Recovery of nitrogen by sudan grass was estimated from yield and plant composition (nitrogen) data. Nitrogen fertilization resulted in an increase in yield and in nitrogen percentage of the plant. Some residual nitrogen was recovered by crops grown beyond the first year, but the total nitrogen recovered over a 3- or 4-year period averaged about 35 percent of the amount applied. Liberal nitrogen fertilization may lead to leaching of significant amounts of nitrate from a claypan soil, resulting in its loss of use by the plant and its probable movement into underground aquifers.

Mo. Agr. Expt. Sta., U. Mo, Columbia, Mo. 65202

118. Titus, J. S., and Catlin, P. B. UPTAKE AND TRANSLOCATION OF UREA-C$^{14}$ SUPPLIED TO ROOTS OF APPLE TREES. Proc. Amer. Soc. Hort. Sci. 86: 1-11. 1965.

Urea-C$^{14}$ was supplied to roots of young apple trees in sand culture and in solution in experiments of 65 minutes to 29 days duration. Selected tissues were extracted and their C$^{14}$ content determined by scintillation counting. C$^{14}$ was partially localized in individual metabolites after paper chromatography and counting. An attempt to counteract the inhibitory effects of ringing on shoot growth by supplying urea to the roots was unsuccessful. C$^{14}$ from urea-C$^{14}$ was, however, translocated past the ring to the top in significant amounts over a 29-day period. After 65- and 90-minute aerated exposures of roots to aerated solutions containing urea-C$^{14}$, activity was much greater in wood than in bark and was associated mainly with urea. After 10 and 12 hours, activity was higher in bark than in wood, and C$^{14}$ was present in a number of metabolites in addition to urea. The movement of urea-C$^{14}$ to the tops was not stopped by ringing, and accumulation below the ring was not indicated. The importance of xylem movement of organic N was emphasized. Apple roots also fixed large quantities of HC$^{14}$O$_3$$^-$ but subsequent translocation of products was lower than after urea-C$^{14}$ feeding.

U. Calif., Davis, Calif. 95616

119. Frink, C. R. APPLE ORCHARD SOIL AND LEAF ANALYSIS. Conn. Agr. Expt. Sta. B. 670, 11 pp. 1965.

A soil test will distinguish between the pH, P, K, Ca, and Mg content of good and poor orchard soils, and a simple visual observation will give an estimate of the N content of the foliage. Having failed to establish the superiority of the more elaborate tissue test, it appears that a quick, simple, inexpensive soil test is the more logical choice.

Conn. Agr. Expt. Sta., New Haven, Conn. 06504

## Soil Biology

See Also 158, 159, 165, 264, 268.

120. Jha, L. K., Ali, M. A., Singh, R., and Bhattacharya, P. B. INCREASING RICE PRODUCTION THROUGH THE INOCULATION OF TOLYPOTHRIX TENUIS. A NITROGEN FIXING BLUE-GREEN ALGA. J. Indian Soc. Soil Sci. 13(3): 161-166. Sept. 1965.

Pot and field trials conducted for 7 years in a neutral loamy soil showed that it was possible to increase the yield of rice through soil inoculation with Tolypothrix tenuis--a blue-green alga. This effect could have been due to the substantial amounts of nitrogen

fixation and the addition of organic matter by this organism. It was also likely that a
good portion of the nitrogen fixed was excreted into the soil.

Dept. Agr., Bihar, India.

121. Schliebe, K. A., Burnside, O. C., and Lavy, T. L. DISSIPATION OF AMIBEN. Weeds
    13(4): 321-325. Oct. 1965.

On three soils, at 1.5 and 15 p.p.m.w. amiben did not inhibit the nitrifying microflora,
but 150 and 1,500 p.p.m.w. significantly reduced the nitrate nitrogen produced by the soil
microflora. No breakdown of amiben in liquid media was detected for 70 days. Amiben had
a net minus charge in solution and traveled at about the same rate on paper strips in
electrophoresis as the dye brilliant blue. The organic matter content of soil was the
property most closely associated with adsorption of C-14⁻ labeled amiben. Only kaolinite,
of four clays studied, adsorbed amiben significantly. There was no volatilization of amiben
from stainless steel planchets stored at temperatures of $15^O$, $25^O$, or $35^O$ C. and relative
humidities of 0, 33, 66, or 100 percent.

San Juan Basin Expt. Sta., Colo. State U. Agr. Expt. Sta., Hesperus, Colo. 81326

## Soil-Plant-Animal Relationships

See Also 159, 165, 179, 181, 184, 197, 198, 203, 242, 251, 260, 261, 266, 300, 302.

122. Locke, L. F., and Eck, H. V. IRON DEFICIENCY IN PLANTS: HOW TO CONTROL
    IT IN YARDS AND GARDENS. U.S. Dept. Agr., Home and Garden B.102, 7 pp.
    1965.

Iron is an essential element for plant growth. Where the amount of iron available to
plants does not meet their minimum needs, the plants fall into a diseased condition called
iron chlorosis.
    Iron chlorosis may occur anywhere in the United States, but is most likely to occur
west of $100^O$ longitude (roughly the western half of the country) and on the sandier soils of
the southeastern part of the country.
    Soil areas that produce chlorotic plants range from a few square feet to many acres
in size.
    An illustrated guide was given on the symptoms and control of iron deficiencies in
plants.

Inform. Div., ARS, USDA, FCB, Hyattsville, Md. 20782

123. Stone, E. L., and Will, G. M. BORON DEFICIENCY IN PINUS RADIATA AND
    PINUS PINASTER. Forest Sci. 11(4): 425-433. 1965.

In Pinus radiata and P. pinaster, boron deficiency produced characteristic injuries
to first year shoots following an initial period of normal elongation. "Shoot dieback" was
marked by death, needle loss, and distortion of an unlignified outer portion, above a
transition zone with shortened discolored needles and maculate pith; abundant fascicle
shoots arose below. In "tip dieback" only the shoot apex was damaged but elongation and

needle length were reduced, and fascicle meristems were stimulated to form buds. Occurrence and severity varied within wide limits. Affected trees had less than 8 p.p.m. boron in undamaged first year needles. Borax applications prevented dieback and increased growth.

Cornell U. Agr. Expt. Sta., N.Y. State Col., Ithaca, N.Y. 14456

124. Ford, E. M., White, G. C., and Allen, M. THE RESPONSE OF MAGNESIUM-DEFICIENT EDWARD VII APPLE TREES TO VARIATIONS IN THE TIMING AND COMPOSITION OF FOLIAR SPRAYS. J. Hort. Sci. 40:351-360. 1965

Magnesium-deficient Edward VII apple trees were used to study the effect of pre-blossom sprays of magnesium sulphate and urea, and to compare the efficiency of post-blossom sprays of magnesium sulphate and chloride.

Two preblossom sprays of 2-percent Epsom salt ($MgSO_4.7H_2O$) prevented the development of early-season magnesium deficiency symptoms but did not increase fruit set. Similar sprays of 0.5 percent urea had no effect on symptoms but increased the set of fruit.

Five postblossom sprays of 2 percent epsom salts largely eliminated both early and late symptoms and produced consistent increases in the magnesium content of the leaves. There was also a large increase in crop, due mainly to a greater fruit set which could be detected after the second spray application. Growth responses also were associated with this treatment.

Five postblossom sprays of 0.83 percent magnesium chloride produced similar responses, except that growth was not affected. Reducing the number of magnesium chloride sprays to three, but applying these sprays over the same time interval, resulted in similar crop responses even though less magnesium was taken up, and symptoms were slightly less effectively controlled.

East Malling Res. Sta., Kent, England.

125. Dow, A. I., and Boawn, L. C. ZINC NEEDS OF CENTRAL WASHINGTON CROPS. Wash. Ext. Serv. Ext. C.290, 6 pp. Rev. 1965.

Zinc deficiency is commonly seen in many central Washington crops. Those most severely affected are: Beans; corn; hops; onions; and Russet Burbank potatoes. Under extreme conditions, zinc deficiency symptoms have also been observed in: Sugarbeets; alfalfa; peas; wheat; sudangrass; soybeans; and potato varieties other than Russet Burbank.

Zinc deficiency can be induced or made worse under certain conditions. These include: Heavy applications of manure; a large accumulation of phosphorus in the soil; and cropping with sugar beets.

An illustrated guide was given on the need and use of zinc fertilizers and sprays.

Ext. Serv., Inst. Agr. Sci. Wash. State U., Pullman, Wash. 99163

126. Heinrichs, D. H., and Troelsen, J. E. VARIABILITY OF CHEMICAL CONSTITUENTS IN AN ALFALFA POPULATION. Canad. J. Plant Sci. 45(5): 405-412. Sept. 1965.

The variability of crude protein, crude fiber, hexosans, pentosans, ether extract, and ash was studied in 100 alfalfa plants selected from a segregating population between intercrosses of Medicago sativa L. and M. falcata L. Plant types as classifed by visual

judgment were unreliable indicators of chemical constituents in plants. Frequency distributions showed that variability among the 100 plants was large for all six chemical constituents in both leaves and stems. There was no significant correlation between leaves and stems for crude protein, crude fiber, ether extract, and ash, but there was a slight positive relationship for hexosans and pentosans. Crude protein and crude fiber content, while giving a correlation coefficient of--.983 in the leaves, gave only--.446 in the stems. Crude protein and hexosan content were negatively correlated in the leaves but not in the stems.

Expt. Farm, Canada Dept. of Agr., Swift Current, Saskatchewan, Canada.

127. Hunter, A. S. EFFECTS OF SILICATE ON UPTAKE OF PHOSPHORUS FROM SOILS BY FOUR CROPS. Soil Sci. 100(6): 391-396. Dec. 1965.

The effects of limestone, slag, and Ca silicate on yield of plants, percent P in plants, total amount of P absorbed by plants, percent of plant P derived from fertilizer, and amount of indigenous soil P taken up by plants were investigated in two pot experiments. The materials were applied at equal $CaCO_3$-equivalent rates. Two soils, two sources of radioactive P, and two crops were involved in each experiment.
In comparison with limestone and slag, Ca silicate significantly increased yields of plants, total P harvested in plants, and indigenous soil P taken up by plants. It was concluded that the silicate ion, present in large amounts, probably increased the availability of soil phosphate by anion exchange. There was no evidence that silicate substituted for phosphate inside the plant.

Agr. Expt. Sta., Pa. State U., University Park, Pa. 16802

128. Hedrick, D. W., McArthur, J. A. B., Oldfield, J. E., and Young, J. A. SEASONAL YIELD AND CHEMICAL CONTENT OF FORAGE MIXTURE ON A PINE WOOD-LAND MEADOW SITE IN NORTHEASTERN OREGON. Oreg. Agr. Expt. Sta. Tech. B. 84, 42 pp. 1965.

Data on the seasonal production and chemical content of 11 forage species and 5 mixtures were obtained on a pine woodland meadow site in the Wallowa Mountain foothills in northeastern Oregon.
Based on an 8-year summary of hay yields, intermediate wheatgrass and hard fescue were the most consistent producers of all single species. Tall wheatgrass exhibited the greatest variability in yields and was hurt measurably by continual close clipping. Meadow foxtail was the only other grass species of those tested to qualify as a suitable long-lived forage for seeding in this area. Grass-legume mixtures were far superior to grasses alone.
Statistical analyses of yields for the years 1958-60 revealed that treatments (species and mixtures), cutting (stage of growth), and the treatment × cutting interaction were all significant during the 3-year period. The significant cutting × fertilizer interaction in 1960 indicated the importance of delaying the first harvest until mid- or late June to receive maximum benefit from fertilizer applications.
Regrowth yields varied among species and years. In seasons of high precipitation, meadow foxtail among grasses and birdsfoot trefoil of the legumes gave the best results. In poorer years, hard fescue and fescue-Whitmar wheatgrass, together with meadow foxtail, were ranked next to intermediate wheatgrass and alfalfa in yield.

Limited grazing trials indicated that cattle preferred creeping meadow foxtail and a mixture of intermediate wheatgrass and alfalfa in both spring and fall. Hard fescue was good in the fall but poor in the spring.

Improved species on meadow sites should be grazed separately from adjoining range and used to supplement the forested ranges.

Agr. Expt. Sta., Oreg. State U., Corvallis, Oreg. 97331

129. Carpenter, P. N., and Murphy, H. J. EFFECTS OF ACCUMULATED FERTILIZER NUTRIENTS IN A MAIN SOIL UPON THE YIELD, QUALITY AND NUTRIENT CONTENT OF POTATO PLANTS. Maine Agr. Expt. Sta. B. 634, 24 pp. Apr. 1965.

A field experiment was conducted from 1951-57 to study the residual effects of phosphorus and potassium, added and/or omitted from potato fertilizers, on yield, quality, and soil residue accumulations of phosphorus and potassium.

Omission of potassium from the potato fertilizer reduced the 7-year average yield 55 bushels per acre as compared to a complete fertilizer.

Omission of phosphorus from the potato fertilizer reduced the yield of tubers 94 bushels.

When both potassium and phosphorus were omitted from the potato fertilizer, a yield reduction of 137 bushels was obtained.

When potash was omitted from the potato fertilizer, specific gravity of the tubers was improved.

Yields for identical fertilizer treatments were reduced where potatoes were grown continuously as compared to a 3-year rotation.

There was a slight trend for lime to decrease both yield and specific gravity of the potato tubers when more than normal maintenance amounts were applied.

Some effects of treatments on nutrition were just beginning to show up in the sixth and seventh years, even though on the basis of yield there seemed to be little or no change after the first few years.

Maine Agr. Expt. Sta., Orono, Maine. 04473

130. Colovos, N. F., Peterson, N. K., Blood, P. T., and Davis, H. A. THE EFFECT OF RATE OF NITROGEN FERTILIZATION, GEOGRAPHIC LOCATION, AND DATE OF HARVEST ON YIELD, ACCEPTABILITY, AND NUTRITIVE VALUE OF TIMOTHY HAY. N.H. Agr. Expt. Sta. B. 486, 14 pp. 1965.

The effects of 50, 100, and 150 lb. per acre of nitrogen fertilization and different dates of harvest on the yield, chemical composition, and nutritive value of the first cutting of 2 varieties of timothy, Commercial and Essex, grown at two different locations were studied for 3 consecutive years with 10 animals.

Acceptability of some of the hays was determined using three Shropshire wethers. Complete energy balances of all the hays with all animals were determined by the use of two open-circuit indirect calorimeters. The nutritive evaluation of all the hays was done on the basis of total digestible nutrients, digestible energy, metabolizable energy, and net energy, all directly determined.

Delay of harvest affected the composition and nutritive value significantly. The crude protein decreased about 40 to 50 percent and the crude fiber increased 20 to 25 percent as the harvest was delayed from June 1 to June 30. The rate of decrease in total digestible nutrients, digestible protein and energy, metabolizable energy, and net energy was from

0.35 to 0.50 percentage units per day as the harvest was delayed after June 1. The order of voluntary intake of some of the hay fed to adult wethers followed that of the digestible and net energy.

The yield in the highest rate of nitrogen fertilization (150 lb. per acre) decreased considerably due to lodging. Also below-average temperatures decreased the yields of the forages in the June 1 and 14 harvests at both locations.

Agr. Expt. Sta., U. N.H., Durham, N.H. 03824.

131. Hanway, J. J., and Moldenhauer, W. C. THE INFLUENCE OF NITROGEN AND PHOSPHORUS FERTILIZATION ON NUTRIENT STATUS AND PROFITABILITY OF BROMEGRASS ON IDA SOILS: II. EFFECT ON CHEMICAL COMPOSITION OF BROMEGRASS. Iowa Agr. Expt. Sta. Res. B. 532: 315-322, 324-327. 1965.

The percent total N in the bromegrass depended upon: (1) The amount of N applied-- the higher the rate of N application, the higher was the percent N in the grass, and the longer the effect lasted; and (2) whether P was applied or not--application of 44 pounds or more of P per acre increased the percent N in the grass where N was adequate but often tended to decrease percent N where N was not adequate.

Recovery of applied N during the 2-year period was essentially constant for all rates of application, with an average of 45 percent for all sites, and did not exceed two-thirds at any site.

The nitrate content of the forage was increased by N applications. In some cases, the nitrate content was further increased where P was applied in addition to N; and, in other cases (especially later cuttings), the nitrate content was decreased where P was applied. Applications of 200 pounds or more of N per acre resulted in potentially toxic levels of nitrate in the forage.

Percent P in the bromegrass forage was increased by P applications, especially where N was applied also. Recovery of applied P was small except where N also was applied. The amount of P recovered in the bromegrass was not much higher from high rates of P than from the lower rates. An average of 45 percent of the low (44-lb./acre) P application was recovered in the forage during 2 years, although as much as 90 percent was recovered at one site. Applications of N and P markedly increased the percent K in the bromegrass.

Agr. and Home Econ. Expt. Sta., Iowa State U. Sci. and Tech., Ames, Iowa. 50010

132. Sartz, R. S. EFFECT OF FOREST LITTER ON GROWTH OF HARDWOOD SEED-LINGS. U.S. Forest Serv. Res. Note LS-59, 2 pp. 1965.

Stands of young hardwood trees were established by direct seeding on three lysimeters in 1934. The soil was a loessial silt loam (Fayette), and the species were red and white oaks (Quercus rubra and Q. alba) and black walnut (Juglans nigra). The seeds were planted just a few inches apart in rows spaced at only 16 inches. This spacing permitted 15 rows of trees per lysimeter.

In the spring of 1936, two of the three lysimeters were covered with a 2- to 3-inch layer of native oak leaf litter to simulate local conditions. The litter was replaced as needed to keep the cover uniform throughout the study. The third lysimeter was not mulched, but was allowed to accumulate litter from natural leaf fall.

Stand inventories were taken the fourth, fifth, sixth, and eighth years after seeding. The difference in growth rates between the mulched and unmulched trees--particularly height growth--was striking. In the fifth year after seeding, the mulched black walnut, red oak, and white oak averaged 55 percent, 51 percent, and 40 percent taller, respectively.

Differences in the eighth year were 42, 53, and 52 percent. However, the balck walnut, which was ill-suited to the soil and site of the lysimeters, practically ceased growing after the fifth year, even on the mulched plot. Growth differences were also reflected in the thinnings. The mulched plots yielded more than twice as much material (air-dry weight) as the unmulched plots--18.2 and 8.5 pounds, respectively.

The faster growth probably resulted from a greater supply of available moisture.

Table.

133. Allison, F. E. DECOMPOSITION OF WOOD AND BARK SAWDUSTS IN SOIL, NITROGEN REQUIREMENTS, AND EFFECTS ON PLANTS. U.S. Dept. Agr., Agr. Res. Serv. Tech. B. 1332, 58 pp. 1965.

Laboratory and vegetation studies with finely ground woods and barks of 28 species of trees were reported. The following results were obtained with these products used in mixture with loam soils:

1. Shortleaf pine wood particles that barely passed through a 6-mesh sieve decomposed about as rapidly as did those of finer grind.
2. The decomposition of a readily decomposable sawdust proceeded slightly more rapidly if the soil reaction was maintained near neutrality than at a pH of 4 to 5.
3. Nitrogen supplied as ammonium or nitrate salts, or as urea, gave equally good results in decomposition experiments with the more readily decomposable woods if the pH was kept above 6.
4. The softwoods, other than shortleaf pine and western white pine, decomposed so slowly when present in soil (Branchville sandy loam) at the 1-percent rate that no nitrogen other than that supplied by the soil was needed for a maximum rate of $CO_2$ release.
5. The hardwoods decomposed much more readily than did most of the softwoods. The $CO_2$ release from the nine hardwoods in 60 days averaged 30.3 percent without fertilizer nitrogen and 45.1 percent with additional nitrogen; the corresponding values for the barks were 22.4 and 24.5 percent.
6. The $CO_2$ release from six woods that were allowed to decompose for 580 to 800 days ranged between 34.6 and 65.3 percent for the woods and between 21.3 and 54.7 percent for the barks.
7. The maximum quantities of nitrogen immobilized (nitrogen requirement) by the micro-organisms that decomposed the woods ranged between 0.3 and 1.4 percent of the dry weight of the woods; the corresponding value for wheat straw was 1.7 percent. The nitrogen requirements averaged 0.61 percent for 19 softwoods and 1.22 percent for 9 hardwoods.
8. Garden peas grown in soil-sawdust mixtures with adequate nutrients present showed no significant toxic effects from the woods and barks of 22 of the 28 species tested. The wood of California incense cedar was very toxic to germination and growth, even at the 1- and 2-percent rates. The bark slightly retarded growth at the 2- and 4-percent rates. White pine bark was somewhat harmful to germination and very injurious to pea seedlings at the 1- and 2-percent rates.
9. Woods and barks, with few exceptions, can be used satisfactorily in agriculture as mulches and for soil humus maintenance if adequate amounts of nutrients, especially nitrogen and sometimes lime, are supplied.

134. Peterson, E. B. INHIBITION OF BLACK SPRUCE PRIMARY ROOTS BY A WATER-SOLUBLE SUBSTANCE IN KALMIA ANGUSTIFOLIA. Forest Sci. 11(4): 473-479. 1965.

Bio-assays indicated that dry leaves of Kalmia angustifolia L. contained a substance that hindered primary root development of black spruce by destruction of epidermal and cortical cells. Final germination percentage of black spruce appeared to be unaffected by Kalmia-leaf extracts. Results with crude and chromatographically partitioned extracts showed that the inhibitory substance was soluble in either ethanol or water. Although the substance was stable in dry leaves, its water solubility suggested that the direct inhibition described may also occur wherever Kalmia predominates.

U. Saskatchewan, Regina, Saskatchewan, Canada.

135. Evans, J. L., Arroyo-Aguilu, J., Taylor, M. W., and Ramage, C. H. DATE OF HARVEST OF NEW JERSEY FORAGES AS RELATED TO THE NUTRITION OF RUMINANT ANIMALS. N.J. Agr. Expt. Sta. B. 814, 16 pp. 1965.

Atlantic alfalfa, common orchardgrass, common timothy, and Lincoln bromegrass were grown on plots in Salem, Middlesex, and Sussex Counties in New Jersey.
Harvest dates for first-growth forage were May 5, May 15, May 25, and June 6. Second and third harvests were made from each of the central New Jersey plots only on July 7 and August 14. The laboratory determinations used in evaluating nutritive value were: Percent cellulose; dry matter; protein (crude and digestible); carotene; and TDN (total digestible nutrients) of the forage dry matter. Dry matter and TDN yields per acre per harvest were calculated, and TDN was estimated from a regression equation developed in a previous study based upon the quantity of forage cellulose disappearance in the presence of rumen microorganisms. The average decrease in TDN was 0.72 pound per 100 pounds of forage dry matter per day of advancing maturity for first-growth forage harvested between May 5 and June 6.
By using some of the later maturing forage varieties, initial harvest dates could be delayed by 1 to 2 weeks. With early first harvests, the total number of harvests per year could be increased by one, which increased the nutritive value of the forage.
Both intake and digestion of forages were reduced by advancing harvest dates with a greater decline per day for first-growth than for regrowth forage. Forage chemical composition reflected this lowered TDN value in that protein, soluble carbohydrate, and carotene decreased while cellulose increased. As forages matured past their optimum harvest dates, plant composition changed, and the amount of grain required to maintain milk production increased.

N.J. Agr. Expt. Sta., Col. Agr., Rutgers--The State U., New Brunswick, N.J. 08903

136. Smith, D. R., and Johnson, W. M. VEGETATION CHARACTERISTICS ON A HIGH-ALTITUDE SHEEP RANGE IN WYOMING. Wyo. Agr. Expt. Sta. B. 430, 14 pp. 1965

During 1961-62, certain aspects of plant phenology, growth, and nutritive values of alpine vegetation were studied at three stations on the Medicine Bow Range of Southern Wyoming.
In this area, the flowering period extends from late June to late August. Among the forbs, some individual plants may be flowering while others are fruiting. Sedges and grasses, however, are more restricted in their period of blooming and fruiting. No discernible differences were noted in phenological development among stations or between grazed and protected areas within stations.

Vegetative growth begins under the winter snow pack. As measured by average leaf length, 30 to 50 percent of the total season's growth may occur before snowmelt. The leaf elongation period is essentially over by mid-July. This growth pattern was consistent among species and between years.

At the individual stations, maximum total standing crop may occur as early as July 1, and it consistently occurs by late July. Standing crop then decreases as the season advances.

Crude protein, which varied considerably among species, followed the usual trend of decreasing as the season progressed. In the species studied, crude-protein content was adequate through mid-August, but after that date some species became marginal for lactating ewes.

Practical application of these results means: (1) Range readiness was not closely related to vegetative growth as in lower areas. Rather, soil moisture and snow pack conditions were more important criteria for determining initial grazing dates. (2) Subalpine forage, in terms of crude-protein level, was generally nutritious and adequately sustained sheep. And (3) some areas produced large amounts of forage--equal to or exceeding forage production at lower elevations.

Agr. Expt. Sta., U. Wyo., Laramie, Wyo. 82071

137. Davis, L. W., Handlin, D. L., Balk, W. A., Wheeler, R. F., and Byrd, W. P. COASTAL BERMUDA GRASS MEAL IN SWINE GESTATION RATIONS. S.C. Agr. Expt. Sta. B. 517, 12 pp. 1965.

Gilts of Hampshire and Berkshire breeds were used to determine if rations composed mainly of dehydrated Coastal Bermuda grass meal was satisfactory for use as swine gestation rations. For 3 years (1961-63), 16 gilts were allotted to four groups and balanced according to breed, weight, and previous treatment.

Each year, two groups were fed a ration consisting of approximately 80 percent Coastal Bermuda grass meal, and the other two were fed a ration of approximately 60 percent Coastal Bermuda grass meal. The rations were balanced with corn and soybean meal for 15 percent crude protein and were fortified with minerals and vitamins. The gilts were assigned to these rations when approximately 7 months of age, and they were bred at 8 months of age. Both gestation rations were pelleted and self-fed during pre-gestation and gestation.

On the 110th day of gestation, each gilt was brought to the farrowing barn and placed in a farrowing pen. The lactation ration, which consisted of only 10 percent Coastal Bermuda grass meal, contained 16 percent crude protein and was hand-fed in meal form. Each gilt was kept on test until her pigs were weaned at 56 days of age.

The average weight of the gilts fed the 80 percent Coastal Bermuda meal on the 110th day of gestation was less ($P < 0.01$) than those fed 60 percent Coastal Bermuda grass meal (368.8 versus 414.7). The average total gain during gestation was less ($P < 0.01$) for those fed 80 percent Coastal Bermuda grass meal (115.2 versus 157.2). The gilts fed the 80 percent Coastal Bermuda grass meal also lost less weight during lactation (46.3 versus 58.7 lb.), but this difference was not significant. The gilts on 80 percent Coastal Bermuda grass meal during gestation were lighter ($P < 0.05$) at weaning time than those fed the 60 percent ration.

There was no significant difference in: Feed consumed per gilt during gestation; feed consumed during lactation; birth weight of pigs; 35-day weights of pigs; weaning weights of pigs; or number of pigs weaned per litter. Cost-and-return calculations showed a slightly lower feed cost for the 80 percent treatment ration which was reflected by a slightly higher return per pig weaned.

S.C. Agr. Expt. Sta., Clemson U., Clemson, S.C. 29631

138. Seidman, G., Hindawi, I. J., and Heck, W. W.  ENVIRONMENTAL CONDITIONS AF-
FECTING THE USE OF PLANTS AS INDICATORS OF AIR POLLUTION.  Air
Pollution Control Assoc. J. 15(4): 168-170.  Apr. 1965.

Plants have long been recognized as useful indicators of air pollution and air pollut-
ants. For some pollutants, such as the phytotoxic components of photochemical smog, plants
have been the sole indicators available. Thus plants have been used as field monitors and as
monitors in both routine and sophisticated laboratory investigations.

These investigations stressed the need for a uniform plant material and a uniform
method of presenting results (the injury index). The author concluded that: (1) Chemical
control of stomatal opening reduced air pollution injury to plants; (2) reduction of water to
plants greatly reduced vegetative damage from photo-chemical air pollutants; (3) plants
grown in soil were less sensitive to irradiated automobile exhaust than were plants grown
in vermiculite; and (4) nutrient level appeared to be related to the sensitivity of pinto
bean to natural smog.

Lab. Med. and Biol. Sci., Pub. Health Serv., Cincinnati, Ohio.


# Soil Classification

See Also 16, 18, 46, 48, 55, 105, 107, 108, 112, 117, 119, 120, 150, 151, 153, 155, 158, 160,
165, 166, 171-173, 175, 176, 179-182, 185, 188, 189, 200, 206, 253, 254, 290, 322, 323-326.

139. High, L. R., Jr., and Picard, M. D.  SEDIMENTARY PETROLOGY AND ORIGIN OF
ANALCIME-ROCK POPO AGIE MEMBER, CHUGWATER (TRIASSIC) FORMA-
TION, WEST-CENTRAL WYOMING.  J. Sedimentary Petrology 35(1): 49-70.  1965.

The Pope Agie Member of the Chugwater (Triassic) Formation is underlain by an
unnamed red bed unit and overlain unconformably in some places by the Nugget (Triassic?)
Sandstone and in others by the Gypsum Spring (Jurassic) Formation. The Popo Agie Mem-
ber was informally divided into the following units of regional extent: Lower carbonate
unit; purple unit; ocher unit; and upper carbonate unit. The upper and lower carbonate
units are characterized by silty and sandy limestones, silty dolomites, and limestone
microconglomerates. The purple and ocher units are characterized by spherulitic anal-
cimolites, analcimic, silty claystones, and analcimic siltstones. Mineral zonation of the
spherules (cryptocrystalline silica (?) center, clay rim, analcime outer shell) is common.

On the basis of five measured and sampled sections of the Popo Agie Member in
west-central Wyoming, there were two main mineral assemblages: (1) Quartz-illite-
feldspar; and (2) Quartz-analcime-montmorillonite-goethite. These assemblages occurred
in three definite mineral zones.

The analcime and the montmorillonite were believed to have originated from the
alteration of volcanic ash by water rich in dissolved salts. Both the volcanic ash and the
water furnished the necessary $Na+$ ions in the analcime.

The principal environments of deposition were believed to have been: (1) Lacustrine
(with volcanic sources) during formation of the analcime and some of the montmorillonite;
(2) lacustrine (no volcanic material) during formation of the carbonates; and (3) fluvial
during formation of some of the montmorillonite and the rocks of the lower and upper
carbonate units (excepting the carbonate beds). Associated tracts and minor modifications
of the main environment also occurred.

Rice U., Houston, Tex.  77001

140. Reeves, C. C., Jr., and Parry, W. T. GEOLOGY OF WEST TEXAS PLUVIAL LAKE
     CARBONATES. Amer. J. Sci. 263(7): 606-615. 1965.

Petrographic and X-ray examination of 14 lacustrine carbonate rocks from 6 pluvial
lake basins on the Southern Llano Estacado showed them to be pure dolomite. Four car-
bonate strata from one other basin were pure calcite associated with volcanic ash. For-
mation of the carbonates by primary chemical precipitation or penecontemporaneous
alteration of calcite was suggested by: Fine grain size (generally less than 2 microns);
lack of organic structures; and association of gypsum and celestite. Precipitation was due
to desiccation of the lakes.

Radiocarbon dates ranged from $17,400 \pm 600$ to more than 37,000 years B.P. The ages
of the samples tended to occur in three major groups at about 18,000, 27,000 and 30,000,
and over 37,000 years B.P. Depositional rate for the carbonates was about 1 inch per 133
years and about 1 inch per 100 years for the clastic lacustrine sediments.

Occurrence of lacustrine carbonates in all the pluvial lake basins on the Southern
Llano Estacado showed the basins predate maximum Wisconsin advance. In fact, car-
bonate dates indicated that nearly all the lacustrine section was premaximum Wisconsin
age.

Tex. Tech. Col., Lubbock, Tex. 79406

141. John, M. K., Sprout, P. N., and Kelley, C. C. THE DISTRIBUTION OF ORGANIC
     PHOSPHORUS IN BRITISH COLUMBIA SOILS AND ITS RELATIONSHIP TO SOIL
     CHARACTERISTICS. Canad. J. Soil Sci. 45: 87-95. 1965.

The relationship of organic phosphorus content to a number of chemical properties
was studied in the surface horizons of 38 soils of 6 different soil orders in British
Columbia.

The concentration of organic P ranged from 1.8 to 77.7 percent of the total P with
amounts varying from 21 to 802 p.p.m. The forested soils of the Podzolic and Brunisolic
Orders contained the least organic P. The wide range in organic P content within some
soil orders indicated that its distribution was not entirely characteristic of the soil order.

Simple correlation studies between organic P and nitrogen, carbon, pH, percent base
saturation, total P, and free iron in all soils before assigning them to groups indicated that
only nitrogen and carbon were significantly related to organic P. Significant relationships
between the other variables and organic P were restricted to specific soil orders. The
organic P content was primarily dependent on nitrogen and pH.

The range of C/organic P and N/organic P ratios for the 38 samples was between 46
and 648 and 5.5 to 57.6 respectively. Soil pH was the only variable studied which could
account for the wide variation of these ratios.

Soil Survey Br., Brit. Columbia Dept. Agr., Kelowna, Brit. Columbia, Canada.

142. Snyder, F. G., and Gerdemann, P. E. EXPLOSIVE IGNEOUS ACTIVITY ALONG AN
     ILLINOIS-MISSOURI-KANSAS AXIS. Amer. J. Sci. 263(6): 465-493. 1965.

Eight distinct geologic events, characterized by intrusive or extrusive igneous activity
and/or intense localized deformation, are alined in a 400-mile east-west trending struc-
tural zone across southern Illinois, Missouri, and eastern Kansas. The geologic features
defining this zone are, from east to west: Hicks dome in Illinois; Avon diatremes, Furnace
Creek volcanic crater, Crooked Creek disturbance, Hazel Green volcanics, Decaturville
disturbance, and Weaubleau fault zone in Missouri; and the Rose dome area in Kansas.

The Furnace Creek structure in Washington County, Mo., represents a period of extrusive volcanism in Upper Cambrian time. Extensive core drilling revealed a crater approximately 7,000 feet in diameter and at least 400 feet deep in Lamotte sandstone. The crater is filled with basic volcanic ejecta and fragments of basement rocks. Surrounding the crater is a thin layer of volcanic ash. The ash bed is in the lower part of the Bonneterre formation, and ash and crater are overlain by a normal Bonneterre section.

The Hazel Green volcanics in Laclede County, Mo., represent a similar period of volcanic activity in early Lamotte time.

Considered as isolated, unrelated phenomena, the individual features along this structural axis were interpreted as cryptovolcanic explosions, meteorite scars, igneous intrusives, and complex fault structures. Details of structure and lithology, subsurface information from core drilling, the remarkable alinement of the features, and the frequent association with basic igneous rocks suggested that these structures were closely related in mode of origin and that they represented intermittent deep-seated faulting and intrusion through a long period of time.

603 S. Gables Blvd., Wheaton, Ill. 60187

143. Heinselman, M. L. STRING BOGS AND OTHER PATTERNED ORGANIC TERRAIN NEAR SENEY, UPPER MICHIGAN. Ecology 46 (1/2): 185-188. 1965.

Treeless string bogs and topographically oriented strips of bog forest were discovered near Seney, Mich., lat. 46° 15' N., perhaps the southern limit of patterned bogs on the North American continent. Patterned ground has developed through paludification of a sandplain dotted with extinct dunes and sloping about 8 feet per mile. Many peatlands in Michigan, Minnesota, and Wisconsin have similar slopes and exhibit patterning in various degrees. Thus the principles that can explain the patterns and bog-forming processes at Seney may apply to large areas of forested and treeless peatland. Studies should be directed toward the interrelations between vegetation, water chemistry, local geology, peatland topography, peat hydrology, peat accumulation, and physical geomorphic processes.

North Central Expt. Sta., FS, USDA, St. Paul Campus, U. Minn., St. Paul, Minn. 55101

144. Forsyth, J. L. AGE OF THE BURIED SOIL IN THE SIDNEY, OHIO, AREA. Amer. J. Sci. 263(7): 571-597. 1965.

The buried soil in a railroad cut 2 miles south of Sidney, Ohio, is unusual in having been developed in till and in having a datable buried log (22,480 ± 800; W-356) lying directly on it. Most helpful in the determination of the age of the buried soil is the nature of the soil itself, which is weakly developed with poor horizonation and a very thin oxidized calcareous zone. Some characteristics are partially obscured by the development of Taschenboden, or subsurface shifting and sorting of particles due to ground ice.

Along Brush Creek, 2 miles farther south, are two other exposures of the soil, both showing strong gleying. The upper Brush Creek section also has a peat (maximum date: >50,000 years), lying just above but associated with the soil and below an overlying till (22,000 ± 1,000; W-414). A short pollen profile from the peat shows poplar, elm, alder, grass, and high percentages of oak pollen, but almost no spruce or pine pollen.

The interval represented by the Sidney soil was fairly long, as shown by the nature of the buried soil, by the species of plants recorded in the pollen profile, and by the radiocarbon dates. The dates showed that the soil-forming interval ended about 22,000 years

ago. The soil, though clearly a paleosol, is not strongly developed, with little clay miner-
alogy alteration or destruction of less-stable heavy minerals. The Sidney soil was believed
to be mid-Wisconsin in age, and the till in which the soil was developed was believed to be
of "early" Wisconsin age, correlating with early Altonian tills in Illinois.

Ohio Geol. Survey, Columbus, Ohio. 43210.

145. Free, G. R. CONSERVATION METHODS FOR SOILS OF THE ONTARIO-MOHAWK
PLAIN AND GLACIATED ALLEGHENY PLATEAU. U.S. Dept. Agr., Agr. Res.
Serv. Agr. Inform. B.291, 15 pp. 1965.

Agriculture is changing rapidly. and new practices in soil and water conservation are
continually being developed for different land resource areas. Cooperative research on
soil and water problems and related studies on two land resource areas--Ontario-Mohawk
Plain and the Glaciated Allegheny Plateau--at Geneva, Marcellus, and the Arnot station
near Ithaca, N.Y., were reported. The research at the Arnot station and Geneva was ended
in 1955 after nearly 20 years, but it is still underway at Marcellus.
Of the land area of the Ontario-Mohawk Plain, 51 percent was classed as cropland and
10 percent was classed as pasture; corresponding values for the Glaciated Allegheny Pla-
teau were 23 and 24 percent, respectively.
The information given was based on the results of the research at these stations and
is applicable to the land resource areas listed above that occur in small portions of New
Jersey and Ohio and in larger areas in New York and Pennsylvania.

Inform Div., ARS, USDA, FCB, Hyattsville, Md. 20782

146. Aandahl, A. R. THE FIRST COMPREHENSIVE SOIL CLASSIFICATION SYSTEM.
J. Soil and Water Conserv. 20(6): 243-246. 1965.

A discussion was given of the comprehensive soil classification used by the National
Cooperation Soil Survey in the United States.

SCS, USDA, Lincoln, Nebr.

147. Olson, G. W. USING SOIL ASSOCIATION MAPS IN NEW YORK. J. Soil and Water
Conserv. 20(3): 83-85. 1965.

The uses of a soil association map for planning urban uses of soils were discussed.
An illustration was given of conversion of a soil association map into a simple map show-
ing soil groups based on major soil characteristics important for urban uses. Soil asso-
ciation maps can conveniently show about 10 soil associations; symbols or colors can be used
to identify the different associations. Such maps can be easily and cheaply reproduced. They
present a readily understandable picture of the soils in an area as large as a county.

Cornell U. Agr. Expt. Sta., N.Y. State Col. Agr., Ithaca, N.Y. 14850

148. Hutchinson, F. E., and Arno, J. R. SOIL SURVEYS FOR URBAN USE IN MAINE.
J. Soil and Water Conserv. 20(3): 85-88. 1965.

The lack of central sewage treatment facilities in many communities in Maine has
prompted an interest in the acceptability of lands surrounding urban centers for use for
private waste disposal systems. The soil scientist can use his knowledge of geologic sub-
strata and the soils developed thereon to predict the suitability of specified areas for this
purpose.

Soil survey reports can and should be used to identify potential problem areas, and then detailed evaluations should be undertaken to measure the physical properties that affect the use of these soils for home development, industrial purposes, and recreation.

A comprehensive plan based on detailed information about the soils in an area can prevent the occurrence of many serious problems, such as nonfunctional septic tank fields, cracks in building foundations, and extremely wet home grounds.

U. Maine, Orono, Maine. 04473

149. Cain, J. M., and Beatty, M. T. DISPOSAL OF SEPTIC TANK EFFLUENT IN SOILS. J. Soil and Water Conserv. 20(3): 101-105. 1965.

Septic tank systems have made it possible for homes beyond the limits of city sewer lines to have modern conveniences for liquid waste disposal. But not all potential building sites have soils capable of properly absorbing septic tank effluent. A review of the literature was given of certain aspects of on-site sewage disposal including discussions of the use of soil survey information for identifying sites suitable for septic tank waste disposal systems, the importance and measurement of soil permeability, the possible sources of soil clogging, and the contamination of ground water by effluent from septic tanks.

With a soil map and the related interpretive information on the soils, it is possible to delineate areas where septic tank systems cannot be used successfully. These areas include poorly drained soils, very fine textured soils, rock outcrops, very steep slopes, and flood plains. Also easily outlined on soils maps are areas where the use of a septic tank system is limited; such areas include somewhat poorly drained soils, slowly permeable soils, and highly variable soils.

The use of soil survey information can contribute much to sound community planning, land use control, and development of regulations for land use applicable to each local situation.

U. Wis., Madison, Wis. 53706

# EROSION CONTROL

## Erosion Equation

150. Barnett, A. P., Rogers, J. S., Holladay, J. H., and Dooley, A. E. SOIL ERODIBILITY FACTORS FOR SELECTED SOILS IN GEORGIA AND SOUTH CAROLINA. Trans. ASAE. 8(3): 393-395. 1965.

Soil erodibility determinations were made for 13 soils on 33 individual sites with a rainfall simulator in the Southern Piedmont and Coastal Plains land resource areas of Georgia and South Carolina. Each test storm consisted of four increments separated by 10-minute intervals, with each increment 30 minutes long, 25 EI (rainfall erosion index) and 2 1/2 inches per hour.

K-factor values computations were based on the equation $K = E_T[(EI_T) = (SL)(C)]$ where K was the soil erodibility index, $E_T$ was total erosion, and $EI_T$ was total kinetic energy times maximum 30-minute intensity; SL was a degree and length of slope factor, and C a crop-management factor.

Total erosion, $E_T$, was directly related to soil texture, initial soil moisture, and storm size. The relation of texture to increasing erosion per EI unit (K factor) was from sand to loamy sand to sandy loam to sandy clay loam to silt loam. The K values for the soils tested

were similar to the values previously measured with natural rain on Cecil sandy loam-sandy clay loam, and to those previously estimated for Lakeland loamy sandy-sandy loam and Norfolk loamy coarse sand (thick surface). The measured K value was higher than the previously estimated value of Georgeville silt loam and lower for the other 10 soil series tested.

SWCRD, ARS, USDA, Watkinsville, Ga. 30677

151. Smith, R. M., and Stamey, W. L. DETERMINING THE RANGE OF TOLERABLE EROSION. Soil Sci. 100(6): 414-424. Dec. 1965.

Attention to erosion in the United States was greatly increased about 35 years ago. Statements by leading soil scientists have suggested that accelerated soil-erosion rates much greater than "normal" or "geologic" erosion should not be tolerated.

Further clarification of erosion tolerance and related concepts has been provided by a mathematical equation developed to assure consistent approaches in research and practice.

Control-plot determinations of erosion with close-growing vegetation at 12 locations in humid regions indicated that normal slope erosion probably was 0.1 to 0.6 ton per acre annually on land suitable for agriculture.

Discharge of major streams was related in a complex manner to soil erosion and renewal in each watershed, providing a measure of the lower bound over long time intervals for all weathering in the watershed plus all influx of earth material removable by erosion. Magnitudes provided by stream-gaging records and calculations of sediments and solubles in the oceans were between 0.1 and 1.0 ton per acre annually for averages of all lands in a number of large watersheds.

Rock weathering as a source of soil renewal in the contact zone with the atmosphere and hydrosphere has been highly variable with time, nature of rock, depth of regolith, and intensity of agents. Overall averages have been estimated as about 0.2 ton per acre annually in the central United States.

Surface deposition over time and over certain regions have provided reserves of favorable soil material that can be used up on a fractional basis without violating accepted definitions of soil conservation.

Erosion tolerance standards based on judgement have been used in soil conservation planning, ranging from 0.5 ton to 6 tons per acre annually.

Logical deductions lead to the conclusion that for soils with large reserves of depth, the judgement tolerances were conservative, whereas for some soils without reserves or with deficiencies of favorable depth, suggested tolerances, were clearly excessive unless accompanied by exceptional soil renewal practices.

Bibliography.

SWCRD, ARS, USDA, Manhattan, Kans. 66504


## Wind and Water Erosion

See Also 1, 4, 7, 10, 12, 17, 68, 150, 151, 156, 157, 173.

152. Siddoway, F. H., Chepil, W. S., and Armbrust, D. V. EFFECT OF KIND, AMOUNT, AND PLACEMENT OF RESIDUE ON WIND EROSION CONTROL. Trans. ASAE 8(3): 327-331. 1965.

Wind erosion varied exponentially with the quantity of residue on the soil surface. Within the limits of the number of independent variables that were evaluated in this wind-tunnel experiment, the elevation of the soil loss-vegetation quantity curves above the

abscissa varied with wind velocity and soil cloddiness. All independent variables influenced the slope of the curves, although the influence of soil cloddiness was relatively minor. The relation between the relative effectiveness of different kinds and orientations of residue was not simple.

The relative value of kinds and orientations of residue for erosion control must be qualified by the soil, wind velocity, and the many other variable characteristics of the residues involved. One can generalize to the extent that: Fine-textured residues on a weight basis were much more effective than coarse-textured residues; any orientation of residue with respect to the soil surface decreased wind erosion more than the flattened position; and, growing fine-leafed crops, like grasses and cereals, afforded a high degree of erosion control per unit weight.

Relatively small quantities of even the coarsest residues resulted in sizable reductions in erodibility compared with the erodibility of bare soil. Amounts of residue that look inconsequential may make a significant contribution and diminish the degree of intensity required of other practices, like strip cropping, shelterbelts, and emergency tillage.

Growing winter wheat oriented in rows normal to the wind was about 1.4 times as effective as winter wheat oriented in rows parallel to wind direction.

Although the independent variables accounted for the major portion (94 percent) of the variation in the log of the log E-R slopes, there was evidence that had interactions been included in the regression model, even more variation could have been accounted for.

SWCRD, ARS, USDA, Sidney, Mont. 59270

153. Doty, C. W., and Carter, C. E. RATES AND PARTICLE-SIZE DISTRIBUTIONS OF SOIL EROSION FROM UNIT SOURCE AREAS. Trans. ASAE 8(3): 309-311. 1965.

Erosion rates and particle-size distribution throughout runoff events were determined from runoff samples collected from unit source areas. Equipment and procedures were developed to obtain samples of runoff at intervals throughout runoff events from 1/4- and 1/45-acre plots. An instantaneous total load sampling device was developed and used to obtain runoff samples from a 1/45-acre fallow plot.

Sediment concentrations were determined from each runoff sample. The eroded sediment was separated into sand, silt, and clay.

The highest erosion rate determined from a 1/4-acre unit source area was 11-1/2 tons per acre per hour. Rates of soil movement varied in the same manner as the runoff. The peak sediment concentration occurred at about the same time or slightly before the runoff peaked.

The proportion of silt increased and the proportion of clay decreased as the sediment concentrations increased up to approximately 20,000 p.p.m. Above 20,000 p.p.m., the particle-size distribution in the runoff samples was approximately the same as the particle-size distribution in the unit source area soil (Grenada silt loam).

There were vast differences in the erosion rates from fallow soil, corn under poor management practice, and corn under improved management practices.

SWCRD, ARS, USDA, Brookings, S. Dak. 57007

154. Meyer, L. D., and Monke, E. J. MECHANICS OF SOIL EROSION BY RAINFALL AND OVERLAND FLOW. Trans. ASAE 8(4): 572-577. 1965.

The mechanics of soil erosion by rainfall and shallow depths of runoff as affected by slope steepness, slope length, and particle size were studied in the laboratory. Erosion from a bed of simulated soil was measured by sampling the runoff for sediment content.

Runoff erosion increased rapidly with increasing slope steepness and length, except at small steepnesses and lengths where essentially no erosion occurred. Smaller particle sizes were more erosive at most slope steepnesses and lengths, but the larger sizes were more erosive at small steepnesses and lengths. Rainfall plus runoff, as compared with runoff alone, increased the erosion of the smaller particle sizes but decreased erosion of the larger sizes.

SWCRD, ARS, USDA, Lafayette, Ind. 47907

155. Swanson, N. P., Dedrick, A. R., and Weakly, H. E. SOIL PARTICLES AND AGGRE-GATES TRANSPORTED IN RUNOFF FROM SIMULATED RAINFALL. Trans. ASAE 8(3): 437, 440. 1965.

In a study of soil particles and soil aggregates transported in runoff from simulated rainfall, the authors concluded that:
1. Soil materials carried by runoff water were aggregated for both a Keith very fine sandy loam and a Sharpsburg silty clay loam. Statistically different soil particle-size distributions were found in the materials carried in runoff when compared to the surface soil of the plots.
2. Soil particle-size distributions did not change significantly in successive samples taken at uniform time intervals during a storm.
3. Water-stable aggregates ranging from 2,000 to 100 microns in diameter were composed of similar particle-size distributions.

SWCRD, ARS, USDA, Lincoln, Nebr. 68503

## Terracing

156. Wittmuss, H. D., and Ehlers, P. MOISTURE CONSERVATION--FLAT CHANNEL TERRACES SHOW PROMISE. U. Nebr. Q. 12(3): 7-8. 1965.

Water limits crop production each year under dryland conditions, especially in Western Nebraska.
Summer fallow, a system of growing a crop every other year, is one method used to increase the storage of soil moisture--but it is inefficient.
Use of alternate sloping contributing areas and level bench areas is another method of making more water available to the growing crop by concentrating the runoff water.
A further refinement is the sealing of the sloping contributing areas to increase the concentration of rainfall on the level bench areas.

U. Nebr. Col. Agr., Agr. Expt. Sta., Lincoln, Nebr. 68503

157. Witmuss, H. D. IS YOUR CONSERVATION SYSTEM UP-TO-DATE? U. Nebr. Q. 12(4): 17-18. 1966.

Methods of conserving our soil and water are changing rapidly. Conservation systems 5 years old or older may be out of date.
Current and future conservation systems differ from earlier terraces designed for small equipment and numerous field obstructions.

Terraces were originally designed to save soil and conduct water off the field in an orderly manner. But we still lose 3 inches of surface water each year as runoff in the Lincoln, Nebr. area. This 3 inches of water would produce 15 or more bushels of corn per acre.

Since the amount of soil loss is in proportion to the amount of water runoff, soil losses could be further reduced by saving all the water for crop production. All the soil and water can be saved by land shaping.

Machines can be operated efficiently on slopes if the land is properly shaped. Waterways obstruct field operations, increase operator fatigue, and reduce machine efficiency. Terraced fields have irregular farmable areas with short rows and numerous turns which further reduces machine efficiency. The best machine efficiency can be obtained on sloping fields, however, with parallel tilled areas shaped to fit the machine and with no field obstructions such as waterways.

Many of the new conservation practices will be installed on the University of Nebraska Rogers Memorial Farm, 15 miles east of Lincoln.

The project objective is to develop a complete conservation system on the entire 320-acre farm. All phases of conservation development, including water diversion, land shaping, underground waterways, and channel improvement, will be investigated and a solution worked out for each conservation problem.

The new conservation systems will differ from present practices in that tile underground waterways will replace grassed waterways.

Underground waterways will be used with both conventional terraces and bench terraces.

U. Nebr. Col. Agr., Agr. Expt. Sta., Lincoln, Nebr. 68503

# Critical Areas

158. Struthers, P. H., and Vimmerstedt, J. P. RAPID STRIPMINE RECLAMATION. Ohio Rpt. 50(6): 84-85, 87. 1965.

Much more rapid and successful reclamation of spoilbanks can be achieved if the methods are directed toward basic land improvement rather than superficial landscaping. Infiltration of additional rain serves several purposes, but the immediate benefit is to dilute and leach out the many tons of mineral salts which form in each acre. Research in Ohio has shown that when spoil materials are exposed to the atmosphere, soluble salt production begins intensively. This is usually at a peak the first year and then diminishes gradually.

Large amounts of solutes have been measured in drainage collected from spoil samples at a depth of 4 feet. Five very acid spoils, toxic to plants, produced an average of 60 tons of salts per acre the first year, and one of them yielded 130 tons. Among 14 non-toxic spoils, the average salt yield was 5 tons per acre, and the highest was 10 tons.

Two basic processes are essential for soil formation on stripmines.

The first process, weathering, has been largely neglected as a practical means for promoting rapid reclamation. Weathering is needed to alter fresh spoil material physically and chemically toward equilibrium with the new surface environment. Weathering can be accelerated by modified grading to achieve maximum leveled land with a loose, rough surface for retention and entry of rain. Between level areas, short steep slopes expose the least amount of spoil to erosion. Where appreciable surface runoff cannot be avoided, water velocity and erosion can be controlled by diversion terraces at gentle grade.

The second process essential in altering spoil to soil involves biological and bio-chemical changes, brought about by living plants and organisms when their influence is added to the environment. The necessary organic matter, fine root distribution, and moist microclimate occur only under very dense vegetative cover.

The achievement of sufficiently dense cover depends as much on proper grading to promote rain infiltration for moisture and good plant growth as on planting the right species.

Ohio Agr. Res. and Develop. Cent., Wooster, Ohio. 43210

# SOIL MANAGEMENT

## Cropping Practices

See Also 51, 152, 171, 180, 203, 219, 222, 255-258, 269, 273.

159.  Maier, C. R.  EFFECTS OF CROP SEQUENCES ON COTTON SEEDLING DISEASES AND PINTO BEAN ROOT ROT.  N. Mex. Agr. Expt. Sta. B. 492, 13 pp.  1965.

Sixteen 4-year crop sequences were evaluated for their effects on cotton seedling diseases and pinto bean root rot. The effects of the individual crops and their residues were also determined.

Both cotton and pinto beans had less seedling loss or root-rot damage on land which previously had lain fallow or had been planted to barley than on land used continuously for cotton or beans.

Two sequences reduced cotton stand loss and bean root-rot severity and increased yields in both crops in the third crop year. Three sequences increased the stand and yield of cotton in the fourth year, and three reduced root rot and increased the yield of beans. Yields were compared with those from plots planted to cotton or beans for 4 years.

Certain sequences reduced yield losses to beans and cotton by selectively modifying the soil microflora. Two sequences reduced populations of Rhizoctonia solani and three decreased Fusarium. After a barley crop or a year of fallow, increases in fungi antagonistic to or competitive with the pathogens resulted in decreases in cotton seedling disease or pinto bean root-rot severity. Thielaviopsis basicola prevalence generally increased, especially with a cotton crop and its incorporated residues. Seasonal fluctuations in soil fungi were greater than the effects of crop sequences, although microflora shifts due to individual crops of their residues were significant. A number of general shifts in the microflora occurred without any apparent relationship to crops, their residues, or cropping sequences.

Tables and charts.

Agr. Expt. Sta., N. Mex. State U., State Col., N. Mex.  88070

160.  Tomlinson, J. F.  AN ECONOMIC EVALUATION OF CROPPING SYSTEMS ON SANDY SOILS IN SOUTHWESTERN OKLAHOMA.  Okla. Agr. Expt. Sta. B. B-634, 32 pp.  1965.

The results were reported of a study to evaluate the economics of some cropping practices and cropping systems for sandy soils of southwestern Oklahoma.

Deep plowing of sandy soils resulted in an economical increase in cotton yields and a more favorable soil for cropping and wind erosion control. The added cotton yields resulting from deep plowing the sandy soil at the Sandy Land Research Station gave a per acre net return of $76.44 for the combined four cotton crops.

Commercial fertilizers on deep plowed sandy soil resulted in a 41 percent increase in cotton yields and an added net return of $13.47 per acre.

The growing of a winter cover crop of rye in a continuous cotton program gave added return to land, risk, and management of $11.46 per acre.

A 7-year cropping system of cotton, grain sorghum, and sweet clover gave an estimated $1,016.61 annual higher return to land, labor, risk, and management for 124.25 acres of sandy crop land than a cotton-grain sorghum cropping system on the same 124.25 acres. Of this increase $831.83 came from the higher cotton yields for the cotton following sweet clover in the cropping system.

A 9-year cropping system of cotton, wheat, and alfalfa gave an estimated $3,758.48 higher annual return to land, labor, risk, and management for 159.75 acres of sandy crop land compared to a cropping system of cotton, wheat, and grain sorghum on the same acres. The higher return was the result of higher cotton yields for the cotton following alfalfa and a higher per acre return for alfalfa over grain sorghum.

Okla. State U. Expt. Sta., Stillwater, Okla.   74075

161.  Bayer, D. E., and Drever, H. R.  THE EFFECTS OF SURFACTANTS ON EFFI-
         CIENCY OF FOLIAR-APPLIED DIURON.  Weeds 13(3): 222-226.  July 1965.

Enhancement of diuron toxicity to oat plants was not dependent on type--anionic, cationic, or nonionic--of surfactant. However, specific surfactant and concentration were important. Concentrations of surfactant above 0.1 percent were required for consistent phytotoxic effects. Concentration of diuron in solution at time of application was not an important factor in phytotoxicity. Lowering the temperature from $72^o$ to $60^o$ F. slowed the expression of toxicity and increased the chances of plant recovery.

U. Calif., Davis, Calif.  95616

162.  Vanden Born, W. H.  THE EFFECT OF DICAMBA AND PICLORAM ON QUACK-
         GRASS, BROMEGRASS AND KENTUCKY BLUEGRASS.  Weeds 13(4): 309-312.
         Oct. 1965.

Watering with 1 surface centimeter or more following spray treatment with dicamba and picloram markedly increased inhibition of shoot growth from rhizome sections of quackgrass (Agropyron repens (L.) Beauv.) and bromegrass (Bromus inermis Leyss). Shoots were most sensitive to the herbicides at early stages of development. Bromegrass and quackgrass were about equally susceptible to the two herbicides. Uptake through roots or rhizomes was more effective than foliar uptake. Kentucky bluegrass in established sod was not injured by dosages of the two herbicides that killed or controlled quackgrass. Young stands of Kentucky bluegrass were more sensitive.

U. Alberta, Edmonton, Alberta, Canada.

163.  Polivka, J. B.  EFFECTIVENESS OF INSECTICIDES APPLIED TO TURF TO
         DESTROY JAPANESE BEETLE LARVAE.  Ohio Agr. Res. and Develop. Cent.
         Res. C. 144, 11 pp.  1965.

The formulation did not make any difference in effectiveness of any of the insecti-cides studied. The 5-lb. rate of chlordane was equally effective when applied as an emul-sifiable concentrate, as a wettable powder, or as granules. However, the lower rates of

chlordane in these same tests were not equally effective. In one test of the 1-lb. rate of chlordane, the grub population was not significantly different from that in the check plot. In the other tests, the 1-lb. rate of chlordane gave complete control of the grubs.

The 1-lb. rates of aldrin, dieldrin, heptachlor, endrin, and Telodrin were effective in all tests.

Two herbicides, Bandane and Zytron, were very effective in eliminating the first generation of the Japanese beetle appearing after the early spring application of these materials for the control of weeds in turf.

Aldrin, chlordane, dieldrin, heptachlor, lead arsenate, and toxaphene persisted in turf soils for a long time. Since Telodrin and endrin are similar to these chlorinated hydro-carbon insecticides, it was assumed that they will be as effective for the same period of time. The amount of actual insecticide applied was the important factor in obtaining complete control of Japanese beetle larvae.

Ohio Agr. Res. and Develop. Cent., Wooster, Ohio. 43210

164. Polivka, J. B. EFFECTIVENESS OF INSECTICIDES FOR THE CONTROL OF WHITE GRUBS IN TURF. Ohio Agr. Res. and Develop. Cent. Res. C. 140, 7 pp. 1965.

Aldrin, chlordane, DDT, dieldrin, endrin, heptachlor, and Telodrin were highly effective in controlling Phyllophaga species for as long as 146 months. All of these insecticides effectively controlled the Cyclocephala species for as long as 13 generations.

The amount of actual toxicant in the formulation was the important factor in the control of these turf grubs. None of the insecticides were 100 percent effective against larvae in the soil at the time of application but all subsequent populations were effectively controlled.

Ohio Agr. Res. and Develop. Cent., Wooster, Ohio. 43210


Crop Residue Management

See Also 152, 208.

165. Smith, J. H. SOME INTER-RELATIONSHIPS BETWEEN DECOMPOSITION OF VARIOUS PLANT RESIDUES AND LOSS OF SOIL ORGANIC MATTER AS MEASURED BY CARBON-14 LABELLING. Rpt. FAO/IAEA Tech. Mtg. Internatl. Soil Sci. Soc. Brunswick-Volkenrode, Sept. 9-14, 1963, Pergamon Press, pp. 223-233. 1965.

The addition of fresh plant material to soil to accelerate the decomposition of indigenous soil organic matter was tested at Beltsville, Md., using C-14-labelled tissue of tops and roots from several crop plants of different maturity stages and C/N ratios.

The following treatments were made on a Prairie soil from North Dakota containing 3.5 percent carbon: (1) The previously stored soil was incubated for 2 weeks before adding the plant material; and (2) there was no preincubation. One percent of C-14-labelled soybean, wheat, or corn plant tops or roots was added to the soil and incubated in a closed system. The evolved $CO_2$ was absorbed in standard NaOH solution that was sampled and titrated at intervals, and the C-14 was counted by liquid scintillation.

In experiments where the soil was not preincubated, a slight increase in soil carbon loss was observed with the addition of mature corn leaves, 28-day-old soybean tops, and mature soybean tops or roots. A reduction in soil organic matter loss was found with the addition of young corn tops or roots, mature corn stalks or roots, wheat straw or roots (both young and mature), 28-day-old soybean roots, and 44-day-old soybean tops or roots.

When the soil was preincubated before addition of the plant material, all plant parts reduced soil carbon loss significantly except immature soybean roots. The addition of corn roots and wheat roots reduced soil organic matter loss about 50 percent. Adding fertilizer nitrogen at rates of up to 400 p.p.m. N in the soil, reducted, but did not eliminate, the protecting effect shown by the corn roots and wheat roots. The strong suppression of decomposition by root residues of wheat and corn suggests that some toxic compound was involved.

SWCRD, ARS, USDA, Twin Falls, Idaho. 83301

166. Clark, D. E., and Hore, F. R. VERTICAL AND HORIZONTAL MULCH ON HALDI-
      MAND CLAY. Trans. ASAE 8(4): 592-593. 1965.

In 1959, an experiment was initiated in Ontario to determine whether the placement of crop residues in a vertical channel or the incorporation of crop residues in the top 6 inches of soil would improve crop yields. The site selected was on a Haldimand clay soil previously used for a deep tillage experiment. The Haldimand clay soil belongs to the Grey-Brown Podzolic soil group and has: An impervious subsoil; a smooth to gently undulating topography; and a soil structure which tends to be poor.

The experimental area of almost 7 acres was divided into two main blocks. Each block contained 18 plots (29 feet by 280 feet) or 6 replications of the mulch treatments.

Neither vertical nor horizontal mulch had a persistent measurable effect on: Crop yields; soil moisture distribution; unit draft of a moldboard plow; or water-table levels.

Ontario Agr. Col., U. Guelph, Guelph, Ontario, Canada.

167. Anderson, D. T. SOME FACTORS AFFECTING TRASH CONSERVATION WITH
      THE HEAVY-DUTY CULTIVATOR. Canad. Agr. Engin. 7(1): 45-46, 49, 56.
      Jan. 1965.

The effects of the use of a rodweeder attachment on surface trash conservation by the heavy-duty cultivator, and of variations in stubble height, were studied during summer-fallowing operations.

The heavy-duty cultivator, equipped with a rod weeder attachment, conserved 12 percent more trash after two operations than the cultivator alone. However, use of the attachment for a third operation reduced this difference.

Surface trash conservation decreased as speed and depth of operation of the heavy-duty cultivator increased. Maximum burial of trash occurred during primary tillage when 72 percent was conserved at a 2-inch depth at a 3-m.p.h. speed compared to 38 percent for 4-inch tillage at 5-m.p.h. speed. After 2 subsequent operations, the conservation values decreased to 52 and 24 percent, respectively. Best over-all trash conservation by the cultivator was obtained from the use of shallow tillage conducted at a moderate speed. Soil conditions influenced the results with the heavy-duty cultivator. Severe burial of trash occurred during primary tillage (up to 60 percent) or during

some secondary tillage operations when the soil was firm and fairly moist. Very little trash burial occurred during secondary tillage when the soil was in a fairly dry and unconsolidated condition.

U. Guelph, Guelph, Ontario, Canada.

# Tillage

See Also 166, 167, 189, 206, 253, 254, 257, 299.

168. Shubek, F., and Kingsley, Q. MINIMUM TILLAGE FOR GROWING CORN. S. Dak. Agr. Expt. Sta. B. 526, 27 pp. 1965.

Minimum tillage methods for growing corn were grouped into four systems: Wheel track planting; hard ground listing; plow plant; and strip processing. There are several combinations and variations of the above four methods.

Minimum tillage is not a panacea for all the problems encountered in growing corn. Each method has its own merits, its own problems, and its own limitations. The advantages for using these methods were: Operating costs were reduced; time was saved; moisture was conserved; and soil compaction was lessened.

Disadvantages were usually associated with: Machinery adaptions; weed control; fertilizer placement; good stands; and maintenance of yields. Under most conditions, these disadvantages were minimized or overcome.

Minimum tillage methods that included use of the plow were usually easier to perfect and more successful in maintaining yields. Minimum tillage can be used in a wide range of soil types, but some methods were better adapted to adverse soil conditions.

Agr. Expt. Sta., S. Dak. Agr. Expt. Sta., Brookings, S. Dak. 57007

169. Fuller, W. H. MINIMUM TILLAGE IN THE SOUTHWEST. Ariz. Agr. Expt. Sta. B. A-39, 16 pp. 1965.

Some tillage practices now used in the irrigated areas of the Southwest have little or no value; others may be harmful. The beneficial and harmful effects of some common tillage practices were described, and means of minimizing necessary but compacting operations were discussed.

The author concluded that: (1) Tillage and traffic cause compaction on most soils; and (2) reduced pore space caused by compaction may reduce yields by decreasing water intake, air movement, and root penetration.

Agr. Expt. Sta., U. Ariz., Tucson, Ariz. 85721

170. Haworth, F., and Bray, J. J. THE EFFECTS OF DIFFERENT PRIMARY CULTIVATIONS AND MANURIAL TREATMENTS ON THE YIELD OF EARLY PEAS, AUTUMN LETTUCE, EARLY SUMMER CAULIFLOWERS, LEEKS AND BRUSSELS SPROUTS. J. Hort. Sci. 40(1): 73-81. 1965.

The effects were described of deep plowing, shallow plowing-with-subsoiling, shallow plowing, and shallow rotary cultivation combined factorially with three manurial treatments on the yields of vegetable crops. Each of the five crops in the rotation was grown in each year from 1960-62 on a sandy loam soil at Wellesbourne, England.

Where a high level of fertility had been built up by the use of farmyard manure (FYM), yields were subsequently maintained at a high level for a 3-year period by the use of NPK fertilizers alone.

Plots which had received either FYM with NPK fertilizers for each crop from 1954-62 (FYM + NPK), or FYM with NPK fertilizers from 1954-59 but with NPK only from 1960-62 (residual FYM + NPK), gave much higher yields than plots which had received only nitrogenous fertilizers from 1954-59 and NPK fertilizers from 1960-62. The increases in yields from FYM + NPK over those from residual FYM + NPK were small and significant only for autumn lettuce and leeks.

Although, on the average, the differences between the yields from the three plowing treatments were small (the largest was 10 percent), some of the differences were significant.

The plowing treatments gave significantly higher yields of early peas, autumn lettuce, leeks, and brussels sprouts than shallow rotary cultivation. With early summer cauliflowers, only shallow plowing-with-subsoiling gave a higher yield than shallow rotary cultivation.

Natl. Veg. Res. Sta., Wellesbourne, Warwick, England.


171. Allmaras, R. R., Burwell, R. E., Larson, W. E., Holt, R. F., and Nelson, W. W.
TOTAL POROSITY AND RANDOM ROUGHNESS OF THE INTERROW ZONE AS INFLUENCED BY TILLAGE. U.S. Dept. Agr., Agr. Res. Serv. Conserv. Res. Rpt. 7, 22 pp. 1965.


Total porosity and random roughness were estimated for the area between 40-inch corn rows (the interrow). These estimates were developed and tested in tillage experiments conducted on Barnes-Aastad, Nicollet-Webster, and Krazburg-Poinsett soil associations in western Minnesota and eastern South Dakota. The tillage treatments were chosen to give a wide variation of total porosity and random roughness.

Large and statistically significant differences in total porosity occurred between a freshly plowed and a plowed-disked-harrowed interrow area. The freshly plowed surface had a greater porosity in the majority of trials. However, the opposite result was observed consistently in the Krazburg-Poinsett and in some cases in the Nicollet-Webster and Barnes-Aastad associations. Much of the difference in porosity resulting from the freshly plowed and plowed-disked-harrowed treatments was explained by the soil moisture content at tillage time in relation to the moisture content at the lower plastic limit. Disking and harrowing decreased the porosity when performed on soil in the friable or harsh range of consistency but increased the porosity when performed on soil in the plastic range of soil consistency.

The random roughness following preplanting tillage was usually associated with the type of tillage treatment. There was evidence that the previous crop affected the random roughness of the plowed interrow areas but did not significantly affect the random roughness of the plowed-disked-harrowed interrow areas.

Frequently, the random roughness index value for spring-plowed interrow areas and the spring-plowed, disked, and harrowed interrow areas was not different from the value for untilled soil at the end of the growing season.

In an investigation consisting of 2 years of tillage following alfalfa, two seasons of the same tillage did not give additive effects on total porosity.


Publication Ed., SWCRD, ARS, USDA, Beltsville, Md. 20705

# Fertility Requirements for Conservation Farming

See Also 48, 50, 113, 114, 116-119, 122-125, 127, 129-131, 133, 160, 165, 168, 170, 172, 197, 203, 206, 214, 216, 217, 231, 252, 259, 279, 290, 329, 330.

172. Brensing, O. H., and Lynd, J. Q. SOIL FERTILITY STUDIES FOR WINTER OAT PRODUCTION IN EASTERN OKLAHOMA. Okla. Agr. Expt. Sta. B. B-637, 14 pp. 1965.

Results from field experiments conducted from 1956-61 to determine oat yield response to various fertilizer treatments in eastern Oklahoma were reported.

The following soil types were studied: Wilson silt loam; Choteau silt loam; Dougherty sandy loam; and Norge sandy loam. Treatment variations included kinds and levels of fertilizers--applied alone and in different combinations--and times of fertilizer application.

Proper nutrient balance, particularly with adequate available soil phosphorus and nitrogen, was required for high oat yields.

Yield response to increased nitrogen fertilization was highly profitable when adequate soil phosphorus was available to the crop. Nitrogen rates up to 80 and 100 pounds N gave highly significant and profitable yield increases when soil phosphorus and potassium were not limiting.

Spring-topdressed nitrogen was as effective as fall-applied nitrogen at all rates of application.

Improved oat forage and grain yields were dependent on adequate nutrient levels of the soil, supplied by proper fertilization. High nitrogen levels with adequate available soil phosphorus were necessary for maximum yields of oats.

Okla. State U. Expt. Sta., Stillwater, Okla. 74075

173. Lyles, L., and Fanning, C. D. EFFECT OF SOIL SALINITY, FERTILIZATION, WATER TABLE DEPTH, AND RUNOFF CONTROL ON PRODUCTION OF NONIRRIGATED GRAIN SORGHUM IN THE LOWER RIO GRANDE VALLEY. Tex. Agr. Expt. Sta. Misc. P. MP-757, 7 pp. 1965

The results of a 3-year study showed no statistically significant differences in grain yields among six fertilizer treatments of nonirrigated grain sorghum. Apparently, nutrient reserves were adequate for maximum production under existing soil salinity and rainfall.

Grain sorghum yields were related to the underground water table depth at seeding, to the fallow season rainfall, and to the soluble salt concentration in the 0- to 3-foot soil depth. Water table depths of 3.35, 5.20, and 7.65 feet at seeding in 1961, 1962, and 1963, respectively, were associated with average grain yields of 3,627, 2,672, and 1,556 pounds per acre. A 1-mmho-per-centimeter increase in soil salinity at the 2- to 3-foot depth resulted in an average decrease of 180 pounds of grain per acre within the 5- to 11-mmhos-per-centimeter range of salt levels exhibited by the test site.

Runoff control did not significantly affect yields any year. Absence of timely runoff, high evapotranspiration between crop seasons, and a high water table that equalized soil moisture storage apparently, explained the lack of yield response to runoff control.

Tex. A&M U., Tex. Agr. Expt. Sta., College Station, Tex. 77843

174. Laws, W. D. INVESTIGATION OF SOME POTASSIUM RELATIONSHIPS OF THE BLACKLAND PRAIRIE AND RELATED SOILS. Tex. Res. Found. Hoblitzelle Agr. Lab. B. 23, 24 pp. 1965.

No profitable response to potassium fertilization was obtained in either greenhouse or field experiments. The exchangeable potassium varied from 188 to 1,102 pounds per acre and the available potassium from 391 to 2,800 pounds per acre.

The transition soils, Wilson and Crockett, were lowest in available potassium. The two blackland soils, Hunt and Houston, were intermediate in available potassium while the Grand Prairie soil was the highest.

The results indicated that blackland soils were not likely to require potassium fertilization for a number of years.

Deep-placement of potassium and phosphorus for corn did not result in increased yield or improved response of corn to these fertilizers even though the fertilizers were in the part of the root zone that was moist for most of the growing season.

Hoblitzelle Agr. Lab., Tex. Res. Found., Renner, Tex. 75079

175. Kamprath, E. J., and Lutz, J. F.  CLAY SOILS NEED MORE PHOSPHATE.  N.C. Res. and Farming 24(1): 7.  1965.

Farmers can benefit from higher applications of phosphate than are commonly being used on the red clay soils of the Piedmont. Not only did heavy phosphate applications increase crop yields, but they also improved soil tilth and water holding capacity.

The eroded red soils of the Piedmont are quite low in available phosphorus. However, they have a large capacity to fix fertilizer phosphorus in a form that is relatively unavailable to plants.

A study of clay soils in Chatham County showed that high corn and wheat yields can be obtained by applying an initial broadcast of phosphorus to build up the supply and then making an annual application to take care of plant needs. An initial application of 700 pounds of $P_2O_5$ per acre and 50 pounds annually produced 110 bushels of corn per acre. Wheat yields were increased from 22 to 34 bushels per acre by the application of 350 pounds of $P_2O_5$ initially and 50 pounds annually.

An initial application of 1,400 pounds of $P_2O_5$ per acre still supplied enough available phosphorus 8 years later for optimum corn yields--114 bushel per acre--without any annual applications.

Where no phosphorus was applied to corn, initially or annually, the yield was 27 bushels per acre. Where the application included only 50 pounds annually, the yield was 92 bushels per acre.

Heavily phosphated soils were loose, mellow, and much more moist than no-phosphate soils.

Field studies on moisture content and bulk density of the soils showed that soil which received heavy application of phosphate had a much higher moisture content and a significantly lower bulk density than the untreated soils.

Agr. Expt. Sta., N.C. State, Raleigh, N.C. 27607

176. Spence, C. O., and Dudley, D. I.  EFFECT OF PHOSPHORUS PLACEMENT AND NITROGEN TIMING ON WHEAT.  Tex. Agr. Expt. Sta. Prog. Rpt. PR-2354, 4 pp. 1965.

Influence of phosphorus. Phosphorus applied directly with the seed produced three to five times as much winter growth as phosphorus banded between seed drills or broadcast. The broadcast phosphorus and phosphorus banded between drills were not assimilated by the plants early enough to affect winter growth. Plots where phosphorus was broadcast or banded between seed drills began to assimilate enough phosphorus by February to give response in the plants.

The average yield on Houston soils with fall-applied nitrogen was 37.6 bushels where phosphorus was with seed, 33.2 bushels where phosphorus was banded between drills, and 33.4 bushels where phosphorus was broadcast. The increase in winter pasture from phosphorus placed with the seed makes this a desirable practice.

Influence of nitrogen. In the test following grain sorghum, it was necessary to apply nitrogen in the fall for maximum winter growth and grain yield. On Houston soils, where wheat followed grain sorghum plots that received fall nitrogen, 10 bushels more grain per acre was produced than those receiving all their nitrogen in the spring.

The test on the Grand Prairie soil followed millet. Fall-applied nitrogen did not increase yields over spring nitrogen and did not increase winter growth at this location. The use of 20 pounds of phosphorus applied with the seed plus half of the nitrogen in the fall and half in the spring gave an average increase of 22.2 bushels per acre where the wheat followed grain sorghum.

Tex. A&M U., Tex. Agr. Expt. Sta., College Station, Tex. 77843

177. Caro, J. H., Freeman, H. P., and Ferretti, R. J. FERTILIZER RAW MATERIALS: REACTIVITY RANGE OF NONBLENDED FLORIDA PEBBLE PHOSPHATE. J. Agr. and Food Chem. 13(1): 84-87. 1965.

Small differences with respect to chemical constitution are noticeable between rocks from different locations within the Florida phosphate field. Those of relatively high carbonate content also have low contents of iron plus aluminum and high calcium-phosphorus ratios. This group is slightly more soluble in fertilizer solvents, but is only indistinctly more reactive in dilute phosphoric acid. Differences between Florida rocks and those from other deposits are much greater than the within-deposit variations, especially in the properties that are considered to influence relative reactivity.

Florida rocks vary widely in physical constitution, but no direct relationship of physical properties to relative reactivity could be found.

Publication Editor, SWCRD, ARS, USDA, Beltsville, Md. 20705

178. Lancaster, J. D., and Savatli, Z. A. FOLIAR APPLICATION OF PHOSPHORUS FOR COTTON. Miss. Agr. Expt. Sta. B. 708, 10 pp. 1965.

Foliar application of phosphorus to cotton during the fruiting period frequently increased the yield where phosphorus deficiency existed but not beyond what could be obtained with soil application alone. Where only slight to moderate phosphorus deficiency existed, foliar feeding was effective.

Earliness of cotton was markedly increased by soil application of phosphorus where a large increase in yield occurred. Phosphate fertilizers seldom increased the yield of cotton in the delta area. Foliar application of phosphorus increased the earliness of cotton only slightly even under conditions of severe phosphorus deficiency.

Late-season foliar feeding was employed to correct a slight phosphorus deficiency, but application beginning early in the fruiting periods was necessary to correct even a moderate deficiency.

In the field experiments, a pound of phosphorus applied to the leaves gave a slightly higher increase in yield than when applied to the soil, but the reverse was true in the cylinder experiment.

Application of dilute solutions of phosphorus were necessary to avoid injury to the leaves. Solutions containing as little as 1.5 percent $P_2O_5$ caused some leaf injury.

Foliar application of the primary (nitrogen, phosphorus, and potassium) and secondary (calcium, sulfur, and magnesium) nutrients to cotton did not appear to be a practical alternative to soil application.

Miss. State U., Agr. Expt. Sta., State College, Miss. 39762

179. Laws, W. D. PHOSPHATE FERTILIZERS FOR CROP PRODUCTION IN THE BLACK-
    LANDS. Hoblitzelle Agr. Lab. B. 21, 32 pp. 1965.

   Research with phosphorus was conducted in the greenhouse, in soil frames, and in field
plots. Tests were made on the effects of sources of phosphorus, rates and ratios, placement,
and soil moisture on phosphorus utilization by plants.
   Little or no response was obtained from summer crops to phosphorus alone, although
there were some notable exceptions as indicated by the results obtained one year with corn
fertilizer with different phosphatic materials.
   Investigations on nitrogen-phosphorus interactions indicated that nitrogen fertilization
enhanced the utilization of phosphate fertilizer.
   Placement studies indicated benefits from applying the phosphorus in bands under the
seed when tap rooted plants were grown but little benefits from banding for fibrous rooted
plants. Phosphate utilization by established sod was much higher when the fertilizer was
placed 4 to 6 inches deep in bands than when it was broadcast on the surface, but the root
injury caused by placement greatly reduced total yield.
   The magnitude of the response to phosphorus was greater under high moisture levels
than under low moisture levels, but on a relative basis the response was slightly higher at
the low moisture level. Adequate phosphatic fertilization greatly increased the efficiency
with which plants used the available moisture.
   Tri-phenyl phosphate, when compared with monosodium, monocalcium, and dicalcium
phosphates, produced the most dry matter with the highest percent phosphorus.

Hoblitzelle Agr. Lab., Texas Res. Found., Renner, Tex. 75079


180. Moschler, W. W., and Jones, G. D. FIELD EXPERIMENTS WITH ROCK PHOSPHATE
    FERTILIZER IN VIRGINIA. Va. Agr. Expt. Sta. Tech. B. 178, 23 pp. 1965.

   Crop yields were summarized for rock phosphate alone, superphosphate alone, and
combinations of the two fertilizers. Corn, wheat, and red clover in rotation, as well as
alfalfa for continuous hay, were test crops in the 14-year (1951-64) experimental period.
Each crop was grown for a number of years on several soil types.
   Equivalence values between rock phosphate and superphosphate (pounds of $P_2O_5$ from
rock phosphate required to produce a yield equal to that produced by 1 pound of $P_2O_5$ from
superphosphate) averaged 1.9 for corn, 4.2 for wheat, 2.0 for red clover, and 1.7 for
alfalfa.
   Soil type was not a critical factor governing comparative efficiency of rock phosphate.
In general, the best results were obtained on the more acid soils such as Nason, Tatum, and
Wellston silt loams, as contrasted to Frederick silt loam or Davidson clay loam. A notable
exception was found on Groseclose silt loam, where rock phosphate was highly efficient in
producing alfalfa (1.1 pounds of rock phosphate $P_2O_5$ equal to 1 pound of superphosphate
$P_2O_5$ ).
   A comparison of the residual values of rock phosphate and superphosphate in 2 years
of cropping on Wellston loam showed that 1.5 pounds of rock phosphate $P_2O_5$ was equiva-
lent to 1 pound of superphosphate $P_2O_5$. Thus, the residual equivalence of the two was
almost identical with the original equivalence (1.6 pounds of rock phosphate $P_2O_5$ equiva-
lent to 1 pound of superphosphate $P_2O_5$).
   Annual applications of superphosphate supplemented with applications of rock phos-
phate at 6-year intervals generally produced yields higher than either source alone.

Va. Agr. Expt. Sta., Va. Polytech. Inst., Blacksburg, Va. 24061

181. Moldenhauer, W. C., Holmberg, G. V., Pesek, J. T., Dumenil, L. C.  THE INFLUENCE OF NITROGEN AND PHOSPHORUS FERTILIZATION OF NUTRIENT STATUS AND PROFITABILITY OF BROMEGRASS ON IDA SOILS: I. EFFECT ON YIELDS AND ECONOMICS OF USE. Iowa Agr. Expt. Sta. Res. B. 532: 305-314, 323-324. 1965.

Net returns from fertilizing established bromegrass stands on areas of Ida soil too steep to farm economically to row crops (over 20% slopes) were determined in 1959-60.

The experiment used a composite design repeated at six locations in the Monona-Ida-Hamburg soil association area. Nitrogen was applied in increments of 100 pounds from 0 to 400 lb./acre in 1959 and 1960. Phosphorus was applied in increments of 44 pounds from 0 to 176 lb./acre in 1959 only.

Multiple regressions of yield on quadratic functions of N and P, plus an interaction term, were calculated from data for each site. Net returns were estimated by using costs of 9, 12, and 15 cents per pound for N; returns of 20, 25, and 30 cents per pound for beef; and 15:1, and 20:1 conversion ratios of forage to beef. Price of P was held constant at 20.62 cents per pound.

Yields from unfertilized plots were very low, averaging 0.58 ton/acre in 1959 and 0.26 ton/acre in 1960. Addition of P fertilizer alone doubled yields over the unfertilized treatment at some sites, gave small increases on others, and even decreased yields in several cases. N applied without P increased yields over the unfertilized treatment, but yields fell far short of those where both N and P were applied. The 400-lb./acre N application did not increase yields greatly over the 300-lb./acre application in most cases. A 400-pound N application was more effective when applied at a rate of 200 pounds per acre per year than at 400 lb./acre once every 2 years.

Highest net annual returns were at the lowest N cost (9 cents), highest beef price (30 cents), and highest conversion ratio of forage to beef (15:1). In most cases, however, optimum N requirements for maximum net annual returns were greater than the 200-pound-per-acre level, considered dangerously high from the standpoint of nitrate accumulations in bromegrass. Calculations of net returns were made at the 200-lb./acre level rather than at the optimum level. Highest calculated average net annual return per acre at the best possible combination of N cost, beef price, and conversion ratio was $57.80, with an annual fertilizer cost of $22.05. The range in net annual return from using the best combination was from $73.10 to $37.60. Calculated average net annual returns at the poorest combination of N cost, beef price, and conversion ratio was $3.60, with an annual fertilizer cost of $2.25.

Caclculated maximum returns per dollar invested in fertilizer were obtained at N applications well below 200 lb./acre. Using the average of six sites, the maximum return for each dollar invested in fertilizer was $3.19 at the most favorable combination of N cost, beef price, and conversion ratio. At one site, the calculated maximum return for each dollar invested at the most favorable combination was $4.60.

Agr. and Home Econ. Expt. Sta., Iowa State U. Sci. and Tech., Ames, Iowa.  50010

182. Kroth, E. M., and Colyer, D.  RESPONSE OF CORN TO NITROGEN FERTILIZER AND PLANT POPULATION IN MISSOURI, 1964. Mo. Agr. Expt. Sta. Sp. Rpt. 47, 15 pp. 1965.

Experiments were conducted for the fourth year in Missouri to determine corn yield response from nitrogen applications at different planting rates. Seven nitrogen treatment rates and four plant population rates were used to test yield response on different soil types at four widely separated locations in the State. The nitrogen applications were at levels between 0 to 200 pounds per acre while the plant population rates were 9,000 to 24,000 plants per acre with different population rates used for different soil types.

The 1964 growing season was relatively unfavorable because precipitation was meager during the latter part of the growing season in most areas of Missouri. Thus lack of moisture limited yield response except in southeastern Missouri where the plots were irrigated. The highest single plot yield was at the Delta Research Center near Portageville and was 159 bushels per acre from a plot with 150 pounds of nitrogen and 24,000 plants per acre. The highest treatment average yield (three replications) was also at Portageville and was 144 bushels per acre from plots with 200 pounds of nitrogen and 19,000 plants per acre.

Yield variations were statistically significant for nitrogen treatments at all four locations, but response varied widely from site to site. Plant population variances were not statistically significant except at the Marshall site where total variation was relatively small. The data from the 4 years indicated that response to nitrogen fertilization and plant population rates varied considerably with moisture, soil type, and other factors.

U. Mo., Agr. Expt. Sta., Columbia, Mo. 65202

183.  Holden, E. R., and Brown, J. W. ZINC CARRIERS FOR CROPS: INFLUENCE OF
      SLOWLY SOLUBLE, SOLUBLE, AND CHELATED ZINC CONTENT AND YIELD OF
      ALFALFA. J. Agr. and Food Chem. 13(2): 180-184. 1965.

The growth of alfalfa on two widely different soils under greenhouse conditions showed that slowly soluble zinc carriers must be at least as fine as 200-mesh for satisfactory performance. Low applications of zinc glasses, though having less effect on zinc content of the crop, increased yield more than a fine crystalline form of zinc sulfate. Zinc ammonium phosphate powder supplied adequate zinc but not when granulated with clay. Hemimorphite ($2ZnO.H_2O.SiO_2$) dissolved at a satisfactory rate in a neutral Florida sand but not in a western calcareous loam. Willemite ($2ZnO.SiO_2$) supplied only very low levels of zinc, and sphalerite (ZnS) had no effect on the crop. Zn EDTA increased zinc content of the crop twice as much as zinc sulfate in neutral soil and up to six times as much in calcareous soil. The influence of the zinc chelate on crop zinc was relatively stable over a 9-month period.

Publication Editor, SWCRD, ARS, USDA, Beltsville, Md. 20705

184.  Nour, M. BLOSSOM-END ROT IN CHILE AS AFFECTED BY CALCIUM AND SOIL
      MOISTURE. N. Mex. Agr. Expt. Sta. B. 495, 10 pp. 1965

In the Middle Rio Grande Valley, chile is susceptible to blossom-end rot--a nonparasitic, physiological disease which lowers pod quality.

No calcium and three rates of calcium sulfate soil applications were combined with low, medium, and high moisture levels to determine effects of calcium and moisture on blossom-end rot. The plant leaves and pods were analyzed at intervals to determine calcium, potassium, and magnesium contents, to discover whether potassium or magnesium also affects the condition. The authors concluded that:

1.  Blossom-end rot decreased with increasing soil moisture and calcium rates.

2.  Calcium in the leaves increased with increasing calcium applications to the soil.

3.  Leaf potassium decreased with increasing calcium applications, but in the pods, potassium increased with increasing calcium.

4. Potassium concentration in the leaves was lower 2 weeks after fruit set than at bloom time, but the potassium concentration in the pods was higher 2 weeks after fruit set than at harvest.

5. Magnesium contents of leaves and pods decreased with increasing calcium applications.

6. Potassium may affect blossom-end rot. This possibility should be studied in more detail.

Tables.

Agr. Expt. Sta., N. Mex. State U., State College, N. Mex. 88070

185. Long, O. H., Overton, J. R., Counce, E. W., and McCutchen, T. LIME AND FER-TILIZER EXPERIMENTS ON SOYBEANS. Tenn. Agr. Expt. Sta. B. 391, 19 pp. 1965.

Lime and/or fertilizer experiments on soybeans conducted in the west Tennessee area over the 5-year period, 1960-64, were summarized. The soil series represented were: Memphis; Loring; Grendad; Callowat, Henry, Dexter, Collins, Hatchie, and Tunica. These soils ranged in internal drainage from well-drained to poorly-drained and in texture from loam to clay loam. Most of the soils were low in phosphorus but ranged from very low to high in potassium. Soil reaction (pH) values ranged from 5.0 to 6.1.

Most of the experiments were conducted over a period of at least 3 years. Lime was applied only at the beginning of the experiments at rates of 2, 3, 4, 6, 8, and 12 tons per acre. In the lime-fertilizer experiments, fertilizer was applied annually at rates ranging from 0-30-30 to 0-120-120 (N-$P_2O_5$-$K_2O$) per acre. In the fertilizer experiments, nitrogen was applied at rates of 30 and 60 pounds of N and phosphorus, and potassium at rates of 40, 80, 120, and 160 pounds of $P_2O_5$ and $K_2O$.

In general, soybeans responded more to lime than to fertilizer. In the lime-fertilizer experiments, the average increase from lime was 6 bushels per acre per year; the average increase from fertilizer was 2.7 bushels.

No response to nitrogen, phosphorus, or potassium was obtained in fertilizer experiments of 2 years' duration on Loring, Tunica, and Collins soils.

Boron had no effect on soybean yields in tests conducted under limed and unlimed conditions on Loring and Tunic soils.

U. Tenn., Agr. Expt. Sta., Knoxville, Tenn. 37901

186. Calder, F. W., Bishop, R. F., MacLeod, L. B., and MacEarhern, C. R. EFFECT OF LIMESTONE ON PASTURE SWARD RENOVATION WITH AND WITHOUT CUL-TIVATION. Canad. J. Soil Sci. 45(3): 251-256. Oct. 1965.

Increases in herbage production ranging from approximately 43 to 96 percent resulted when various rates of limestone, together with fertilizer and a forage seed mixture, were applied to the surface of a sparse sward. When these treatments were applied to the surface of a dense sward, increases ranged from approximately 9 to 25 percent. On both sward types, cultivation and incorporation of fertilizer and limestone almost invariably produced yields which were significantly higher than those obtained when the treatments were applied on the surface.

Expt. Farm, Canada Dept. Agr., Nappan, Nova Scotia, Canada.

# Salinity and Alkali Problems

187. Fiering, M. B. REVITALIZING A FERTILE PLAIN; A CASE STUDY IN SIMULA-
TION AND SYSTEMS ANALYSIS OF SALINE AND WATERLOGGED AREAS. Water
Resources Res. 1(1): 41-61. 1965.

Systems analysis and digital computer simulation were applied to the control of
waterlogging and salinity in West Pakistan. The systems approach and the demonstration
of digital computer applicability to civil engineering problems were described.

The history of waterlogging and salinity of agricultural lands in West Pakistan is
the byproduct of a truly remarkable system of crop irrigation which has been employed
in increasing intensity over a period of some 3,000 years.

During the early part of this century, British hydraulic engineers initiated the barrage
system of irrigation and began to divert large quantities of water from the mighty Indus
River and the five great tributaries that drain the Punjab region of the subcontinent.
The economic and technologic aspects of the remedy were discussed; the role of the
digital computer was seen to be essential to the concept and thrust of an operations
research solution.

Harvard U., Cambridge, Mass. 02138

188. Johnsgard, G. A. SALT AFFECTED PROBLEM SOILS IN NORTH DAKOTA. N. Dak.
Agr. Expt. Sta. B. 453, 15 pp. 1965.

A detailed report was given on the identification, management, correction, and im-
provement of the following salt affected problem soils in North Dakota: Saline soils; sodic
(alkali) soils; and high lime (calcareous) soils.

Tables were presented on the tolerance of field crops to saline and sodic soil
conditions.

Agr. Expt. Sta., N. Dak. State U., Fargo, N. Dak. 58103

189. Rasmussen, W. W. DEEP PLOWING FOR IMPROVING "SLICK SPOT" SOILS. Crops
and Soils 17(7): 10-11. 1965.

Farmers are rapidly accepting deep plowing--30 to 36 inches--as a management
practice for soil improvement and for reclaiming unproductive areas of saline-sodic
"slick spot" soils. Such soils infest large areas of irrigated land in southwestern Idaho
and southeastern Oregon.

The "slick spots" are small scattered areas of Solonetz-like soil containing exces-
sive exchangeable sodium soluble salts and frequently cemented hardpan silica-lime
layers in the lower profile. The affected soils have extremely low water-intake rates
and are resistant to normal soil improvement procedures.

Slick spot soils occur in complexes with nonsalt-affected soils with similar profile
characteristics and inherently poor structure. Some associated soils may have cemented
hardpan and compact soil layers that limit water infiltration and restrict root penetration.
In this region, the slick spots occur principally in association with medium-textured high
silt soils with the surface soils generally derived from or influenced by loess soil.

Deep plowing of irrigated farmlands affected by unfavorable solonetzic or slick spot
soil areas appears to be a feasible and economical practice for general soil improvement
and for reclaiming the nonproductive saline-sodic soil areas.

The affected soils can be plowed to adequate depths with a 4-foot moldboard plow at costs varying from $35 to $45 per acre. Where deep plowing is beneficial, it should be supplemented with effective irrigation, good fertility, and good soil management practices.

SWCRD, ARS, USDA, Kimberly (Twin Falls), Idaho. 83341

190. Hanshaw, B. B., Back, W., Rubin, M., and Wait, R. RELATION OF CARBON 14 CONCENTRATIONS TO SALINE WATER CONTAMINATION OF COASTAL AQUIFERS. Water Resources Res. 1(1): 109-114. 1965.

Naturally occurring stable or radioactive isotopes may be used in some places to identify the origin of saline water that contaminates some coastal aquifers. In a recent study to determine the origin of saline water in the Ocala Limestone aquifer near Brunswick, Ga., the following sources were analyzed for C-14 and deuterium concentrations: Potable water from the Ocala Limestone; contaminated water from the Ocala Limestone; saline water from the underlying Claiborne Group; and nearby ocean water. The chloride concentration of the groundwater ranged from about 25 p.p.m. in the potable water to more than 2,000 p.p.m. in the deeper part of the Claiborne Group.

From an interpretation of piezometric maps and other hydrologic data, previous investigators had concluded that the source of the contaminating water was the Claiborne Group and not the nearby ocean. The essentially uniform range of low values of -965 to -987 percent of the modern standard (National Bureau Standard C-14 oxalic acid) for the C-14 activity of the groundwater samples (regardless of the degree of contamination) was in agreement with this conclusion. If recent ocean water, which had a C-14 value of +285 percent, were the source of contamination, the contaminated water would have had a C-14 activity higher than the activity of the fresh water. Deuterium analyses were not inconsistent with the interpretation that water from the Claiborne Group, rather than recent ocean water, was the source of the contaminating water. The concurrence of the hydrologic and the isotopic data in this area where the hydrology is well known suggests that isotopic analysis may be used to identify the origin of water in different portions of a hydrologic environment.

U.S. Geol. Survey, Washington, D.C. 20240


## Cover Crops and Green Manure Crops

See 160.


## Climatic Influences

See Also 4, 8, 10, 11, 15, 16, 19, 25, 46, 60, 67, 100, 130, 150, 154, 158, 182, 236, 243, 253, 323, 331.

191. Dethier, B. E. THE CLIMATE OF THE NORTHEAST: PRECIPITATION PROBABILITIES. Cornell U. Agr. Expt. Sta. B. 1005 (Northeast Reg. Res. P.), 39 pp. 1965.

The precipitation probabilities were given in table form for Northeastern United States for 1-, 2-, and 3-week periods.

Cornell U. Agr. Expt. Sta., N.Y. State Col. Agr., Ithaca, N.Y. 14850

192. Hershfield, D. M.  METHOD FOR ESTIMATING PROBABLE MAXIMUM RAINFALL.
      J. Amer. Water Works Assoc. 57(8): 965-972. 1965.

A discussion was given of the different methods used for estimating probable maximum rainfall.

Large rainfalls may be considered the kingpins that determine the size of hydraulic structures regulating the flow to and in watersheds, culverts, sewers, dams, and spillways. In situations in which the risk of the structure's failure must be minimized, the probable maximum rainfall (or precipitation) is considered in determining the size of the structure. The term "probable maximum rainfall" is meant to indicate that estimates of the amount of rainfall for a particular location have been adjusted upward to their climatologic potential. There is no absolute criterion, however, for distinguishing the quality of estimates at a particular location that are in excess of the maximum observed rainfall at the location.

SWCRD, ARS, USDA, Beltsville, Md. 20705


193. Ratliff, R. D., and Reppert, J. N.  AN ECONOMICAL STORAGE PRECIPITATION
      GAGE. U.S. Forest Serv. Res. Note PSW-62, 4 pp. 1965.

An economical "can-cone" - type storage precipitation gage, based on one originally designed by the California Department of Water Resources, was described. The cone was modified by including an inner skirt to prevent loss of water between the cone and the can. Periodic records of precipitation were obtained by stick measurement. Five complete cones cost $120.00.

Pacific Southwest Forest and Range Expt. Sta., FS, USDA, Berkeley, Calif. 94701


194. Martinelli, M., Jr. ACCUMULATION OF SNOW IN ALPINE AREAS OF CENTRAL
      COLORADO AND MEANS OF INFLUENCING IT. J. Glaciology 5(41): 625-636. 1965.

The accumulation of snow in terrain depressions was studied in an alpine basin in central Colorado. Snow fences and a jet roof were built upwind of several natural catchments to see if such barriers could be used in the combination with terrain features to produce snow fields that would persist until late summer. At three of the six test sites, fences increased snow depths appreciably, and the snow fields persisted longer than usual. At the other test sites, snow depths were increased close behind the fences but were decreased farther downwind with no net increase in the amount of snow caught.

Rocky Mountain Forest and Range Expt. Sta., FS, USDA, Fort Collins, Colo. 80521


195. Carolus, R. L., Erickson, A. E., Kidder, E. H., and Wheaton, R. Z.  THE INTER-
      ACTION OF CLIMATE AND SOIL MOISTURE ON WATER USE, GROWTH AND DE-
      VELOPMENT OF TOMATOES. Mich. State U., Q. B. 47(4): 542-581. May 1965.

Tomato growth and development in a soil moisture controlled field study were more significantly influenced by variation in atmospheric stress than by the level of available soil moisture (ASM). Fruit productivity was increased 120 percent in a season of high stress but decreased 15 percent under low stress with very high (85 percent) relative to low (20 percent) ASM. As ASM increased from low to very high, under high stress, fruit number increased 47 percent--fruit size, 49 percent; however, under low stress fruit did not vary significantly in size and 23 percent fewer fruits were produced.

Fruit soluble solids varied directly with the water stress imposed on the plant by a combination of soil moisture tension and atmospheric stress. Blossom-end rot of fruit was related to a combination of high soil moisture tension and atmospheric stress; blotchy ripening was due to a low diffusion pressure deficit in the plant, resulting from low soil and/or atmospheric stresses. Evaporative cooling of the microclimate of the plant by 0.04 to 0.06 inches of irrigation per hour was indicated as a more effective method of assuring continued optimum plant functioning during periods of atmospheric stress in humid climates, than temporarily saturating the surface soil with water.

Agr. Expt. Sta., Mich. State U., East Lansing, Mich. 48823

196. Neild, R. E., and Young, J. O. COMPARATIVE CLIMATOLOGY AS AN APPROACH FOR DEFINING THE APPROXIMATE GROWING SEASON FOR VEGETABLES IN NEBRASKA. Nebr. Agr. Expt. Sta., STA. B. SB 488, 14 pp. 1965.

Lacking long-term commercial experience in vegetable crop production, a technique was developed for defining growing season for certain vegetables in Nebraska. Temperature and time parameters were presented for determining the approximate planting and harvest dates most favorable for crop production. The procedure provides a basis for increased efficiency in research and development and a contribution to economic projections.

Application of these parameters to climatological data showed major differences between the growing season for specific crops and the "frost-free season" which decreased from east to west across the State. The length of the growing season for warm season crops was related to length of the frost-free season, but certain cool season vegetables had a longer growing season in western Nebraska.

Tables and graphs.

U. Nebr. Col. Agr. and Home Econ., Agr. Expt. Sta., Lincoln, Nebr. 68503

197. Mack, A. R. EFFECT OF SOIL TEMPERATURE AND MOISTURE ON YIELD AND NUTRIENT UPTAKE BY BARLEY. Canad. J. Soil Sci. 45(3): 337-346. Oct. 1965.

In a field experiment, yields of barley were lower, regardless of moisture, when the mean minimal soil temperature was near $27^O$ than when it was near $9^O$ or $18^O$ C. The highest yields were obtained at $18^O$ C. Application of fertilizer increased final yields and uptake of N, P, and K at $9^O$ and $18^O$ but not at $27^O$ C. At $9^O$ and $18^O$ C., response to added fertilizer occurred as the moisture content of the soil was raised from near the wilting point to field capacity. During the early stages of growth, an increase either in temperature or moisture increased the uptake of N, P, and K. Percentage P in the plant material during early growth was related to yield near heading stage when soil temperature conditions were considered. The protein content of the grain was increased at the higher soil temperature for all moisture conditions.

Soil Res. Inst., Canada Dept. Agr., Ottawa, Canada.

198. Baker, D. G., and Strub, J. H., Jr. CLIMATE OF MINNESOTA: PART III. TEMPERATURE AND ITS APPLICATION. Minn. Agr. Expt. Sta. Tech. B. 248, 64 pp. 1965.

Air temperature data for Minnesota were summarized. Data were based upon the 66 U.S. Weather Bureau cooperative and class A stations with continuous records from 1931-60. Normal average daily and average monthly maximum and minimum, and extreme

maximum and minimum air temperatures were presented. Also shown were computed effective day and night temperatures, growing degree days, and heating degree days for each station.

A brief summary was given of published information relative to apparent effects of air temperature upon various animals and plants. An attempt was made to show a possible northern growing limit for certain varieties or crops grown in southern Minnesota. In addition, 12 representative stations were ranked according to their ability to meet the optimum day and night temperature requirements of various crops.

U. Minn., Agr. Expt. Sta., St. Paul, Minn. 55101

199. Baier, W., and Robertson, G. W. ESTIMATION OF LATENT EVAPORATION FROM SIMPLE WEATHER OBSERVATIONS. Canad. J. Plant Sci. 45(3): 276-284. 1965.

A technique was presented for estimating daily latent evaporation from simple meteorological observations and astronomical data readily available from tables. From climatological records taken at six agricultural research establishments across Canada during 5 years, multiple regression equations were evolved to estimate daily latent evaporation from three to six variables. With observations of only maximum and minimum temperature available and extra terrestrial radiation from tables, the correlation coefficient with latent evaporation was highly significant ($r = 0.68$). The inclusion of any one or two of the variables of solar energy, vapor pressure deficit, and wind resulted in correlation coefficients ranging from 0.75 to 0.81. With all six variables involved ($r = 0.84$) 70 percent of the variations of latent evaporation could be explained by variations of the meteorological parameters.

The reliability of the estimate could be further improved if daily values of estimated latent evaporation were accumulated over a period of up to 16 days depending on the method employed.

Plant Res. Inst., Canada Dept. Agr., Ottawa, Ontario, Canada.

200. Calder, F. W., MacLeod, L. B., and Jackson, L. P. EFFECT OF SOIL MOISTURE CONTENT AND STAGE OF DEVELOPMENT ON COLD-HARDINESS OF THE ALFALFA PLANT. Canad. J. Plant Sci. 45(3): 211-218. 1965.

Alfalfa plants were grown in the greenhouse to three developmental stages: (1) Vegetative (48 days old); (2) early bud (62 days old); and (3) 50 percent bloom (78 days old). The plants were then hardened and subjected to freezing temperatures in an environmental control chamber. Prior to hardening, the Tormentine sandy loam soil in which the plants were growing was brought to three moisture levels: (1) 25 percent of field capacity; (2) field capacity; and (3) saturation.

Electrical conductivity of plant exudate from top growth of plants decreased during hardening and with freezing. Conductivity of root exudate increased during hardening but decreased during freezing.

Plants were rated for freezing damage immediately after freezing and 10 days later. Recovery was significantly higher for plants grown on soils at field capacity than at saturation. Differences in regrowth between 25 percent of field capacity and field capacity were not significant. Total available carboyhdrate content and etiolated regrowth were also higher for plants grown in soil at field capacity.

Saturated soil had an extremely adverse effect on development of cold-hardiness of alfalfa plants as compared with the effect of field capacity and that of 25 percent of field capacity.

Plants that were mature before hardening and freezing were more hardy under field capacity conditions than less mature stages of plants, as shown by weight of aerial and root portions of plants, carboyhdrates, conductivity, growth without light, and rating of recovery after freezing.

Expt. Farm, Canada Dept. Agr., Nappan, Nova Scotia, Canada.

201. Bailey, M. A., and Maxwell N. THE USE OF SOLID PETROLEUM FUEL BLOCKS UNDER-THE-TREE FOR COLD PROTECTION IN CITRUS ORCHARDS. Tex. Agr. Expt. Sta. Prog. Rpt. 2361, 5 pp. 1965.

Two models of under-the-tree heaters which utilize solid petroleum wax as a fuel source were tested extensively in citrus groves in the Lower Rio Grande Valley during the winter of 1964-65. These heaters burned at the rate of approximately 20,000 B.t.u.'s per hour and were readily ignited with an ordinary grove torch.

Single tree tests indicated the heaters should be placed symmetrically around the tree and 3 to 4 feet from the trunk. Acreage tests showed that it was possible under still conditions to maintain a $9^o$ to $13^o$ F. temperature increase in large citrus trees with 3 to 4 heaters per tree. A much higher increase was maintained in the center of the tree, the area of the trunk, and the main framework limbs. As the wind velocity increased, the effect of the heater was lessened, although a $3^o$ to $7^o$ F. differential was maintained when winds were 5 to 12 miles per hour.

Tex. A.&M. U., Agr. Expt. Sta., College Station, Tex. 77843

202. Berry, C. R. BREAKING DORMANCY IN EASTERN WHITE PINE: BY COLD AND LIGHT. U.S. Forest Serv. Res. Note SE-43, 4 pp. 1965.

Eight weeks' exposure to a temperature of $40^o$ F. $\pm 2^o$ and 9 hours of light per day satisfied the cold and light requirements of dormant eastern white pine seedlings. Growth was resumed in the greenhouse following such treatment. Dormancy was not broken with only 2 weeks' chilling; after 4 and 6 weeks' chilling, flushing was slower, and some seedlings failed to respond. Seedlings given from 1 to 10 weeks' exposure to room temperature and 9 hours' light per day before chilling did not differ noticeably in flushing from seedlings that received no pretreatment.

Southeastern Forest Expt. Sta., FS, USDA, Asheville, N.C. 28802

203. Power, J. F. SOIL TEMPERATURE, MOISTURE, AND PHOSPHORUS AVAIL-ABILITY. Agrichemical West. 8(4): 11, 36. Apr. 1965.

In a series of growth room experiments, the effects of soil temperature on the growth and phosphorus nutrition of spring barley were studied on a Parshall fine sandy loam. With a low P soil (4 p.p.m. $NaHCO_3$-soluble P) and no P fertilization, barley growth was very poor over the entire soil temperature range of $45^o$ to $80^o$ F. However, with a high rate of P fertilization on either a low or medium P soil, excellent barley growth resulted over the soil temperature range of $52^o$ to $73^o$ F. Greatest growth occurred at a soil temperature of $59^o$ F., but growth at all temperatures in the $52^o$ to $73^o$ F. range was at least 90 percent of that at $59^o$ F.

After harvesting, the plants were analyzed for total phosphorus content. As either the soluble soil or fertilizer P supply was increased, P concentrations in the plant material also increased. When P concentrations were plotted against dry weights, a separate

relationship was found for each temperature. Dry weights were generally greatest for the 59° F. soil temperature for any given P concentration. The curve for 59° F. was a typical expression of the theory of plant tissue analysis.

By maintaining his soil at a high fertility level, the grain producer can partially overcome the adverse effects of high or low temperatures. With lower fertility levels, not only were yields generally lower but also crop growth was much more sensitive to variations in soil temperature. These results would have particular application to grain produced on fallow or with irrigation, where moisture is not too limiting. However, a good fertility program would not alleviate crop failures under conditions of extreme drought and high temperatures.

SWCRD, ARS, USDA, Mandan, N. Dak. 58554

204. MacDowall, F. D. H. PREDISPOSITION OF TOBACCO TO OZONE DAMAGE. Canad. J. Plant Sci. 45(1): 1-12. 1965.

Effects of ontogeny, genome, nitrogen, water supplies, and ozone itself in predisposing tobacco plants to ozone damage (including weather fleck) were described from experiments in both field and greenhouse. The fully expanded leaf became susceptible to low doses of ozone at the time its protein content started to fall. Topping slowed the development of susceptibility of leaves, with the result that the susceptibility of the plants was decreased. Effects of genome were at least partly of an ontogenetic nature. Susceptibility was enhanced by both deficiency and excess of nitrogen. Moisture prior to fumigation increased susceptibility. Long-term effects of moisture supply were akin to its influence on drought-hardiness. Susceptibility was increased by shortened photoperiod, low day temperature, and high night temperature. A large or a small dose of ozone appeared to predispose against or toward, respectively, susceptibility to the next dose. Wherever tested, stomatal opening was positively associated with damage. Since stomatal opening regulates the flux of ozone into the leaf, it controls the amount of damage to tissue of a given susceptibility.

Plant Res. Inst., Canada Dept. Agr., Ottawa, Ontario, Canada.

205. Agricultural Research Service. SOLAR STILL FOR SURVIVAL WATER. U.S. Dept. Agr., Agr. Res. Serv. Picture Story 187, 4 pp. Aug. 1965.

An illustrated report was given on the construction and use of a solar still for emergency survival water in dry areas.

ARS, USDA, Inform. Div., FCB, Hyattsville, Md. 20782

## Surface Soil Removal

206. Gingrich, J. R., and Oswalt, E. S. SOIL MANAGEMENT PRACTICES FOR COTTON PRODUCTION ON LEVELED IRRIGATION LAND. Okla. Agr. Expt. Sta. B. B-636, 15 pp. 1965.

Nitrogen was the most important consideration for cotton production on an irrigated Reinach silt loam that had most of the topsoil removed by leveling. Almost always, the 120-pound N rate produced significantly higher lint yields than the 60-pound rate.

The value of nitrogen and other constituents in manure and cotton burs was high. For the 2 years these materials were applied, supplemented with 60 pounds of N per acre, they were always among the five highest yielding treatments.

The response of this soil to phosphorus was not as striking and consistent as the response to nitrogen. For the most part when the 120-pound N rate was applied, the response to phosphate application was not great when concentrated superphosphate was used. When ordinary superphosphate was used at either the 17.5-pound or 35-pound per acre rate, lint yields usually were higher. In view of the greenhouse study in 1961, the greater response to ordinary superphosphate could be due to the sulfur it contained.

Chiseling or deep placement of fertilizer showed little or no beneficial effects on the cut area.

The response to fertilizer was much more erratic on the fill area than on the cut area. For the most part, nitrogen was still the most important nutrient to consider.

The effects of phosphorus on lint yields from two experiments were very erratic. It would seem from the limited data that there was very little to be gained from using phosphorus on the fill area.

Data from two experiments indicated that subsoiling the fill area would be beneficial although there was no advantage for deep fertilizer placement. Chiseling the first time increased lint yields from 100 to 140 pounds per acre.

Okla. State U. Expt. Sta., Stillwater, Okla. 74075

## Mulching

See Also 132, 133.

207. Harris, R. E. POLYETHYLENE COVERS AND MULCHES FOR CORN AND BEAN PRODUCTION IN NORTHERN REGIONS. Proc. Amer. Soc. Hort. Sci. 87: 288-294. 1965.

Soil Temperature and moisture, and the growth and yield of corn and bush beans were compared when the plants were grown using the following methods: Under polyethylene covered row-tents (cloches); 3-foot wide black polyethylene mulch; 1-, 2-, 3-, and 4-foot wide clear polyethylene mulches; and untreated checks.

Clear polyethylene mulches increased soil temperature by up to $15^o$ F. over the control, conserved moisture, advanced maturity, and increased yields. The beneficial effects were highest in the 4-foot mulch and decreased with width of mulch.

Black polyethylene mulches increased minimum but decreased maximum soil temperatures in the spring and increased both minimum and maximum soil temperatures during the summer, conserved moisture, advanced maturity of beans slightly, and increased yields of both corn and beans.

Row-tents advanced maturity of corn and increased yield of corn and beans but had little effect on soil temperature and moisture.

Canada Dept. Agr., Beaverlodge, Alberta, Canada.

208. Swanson, N. P., Dedrick, A. R., Weakly, H. E., and Haise, H. R. EVALUATION OF MULCHES FOR WATER-EROSION CONTROL. Trans. ASAE 8(3): 438-440. 1965.

Of the treatments tested, an asphalt emulsion applied at 1 quart per square yard and a 1/2-ton-per-acre prairie hay mulch anchored with such an asphalt emulsion provided the best protection against water erosion.

Prairie hay and wheat straw were comparable in their effectiveness as mulches for protection against water erosion and were more effective than woodchips. The 6-ton mulch of woodchips was comparable to the 1-ton-per-acre mulches of hay or straw.

Equal amounts of prairie hay mulch applied as a loose mulch or anchored with a disk packer were not significantly different in amount of protection provided against water erosion. Crossslope operation of the disk packer provided better protection than up-and-down slope operation. Disked-in woodchips provided less protection than woodchips left entirely on the soil surface.

SWCRD, ARS, USDA, Lincoln, Nebr. 68503

209. Robinson, J. B. D., and Hosegood, P. H. EFFECTS OF ORGANIC MULCH ON FERTILITY OF A LATOSOLIC COFFEE SOIL IN KENYA. Expt. Agr. 1(1): 67-80. 1965.

Measurements were reported on the influence of mulch on the chemical and physical characteristics of the soil, the chemical composition of the crop, and growth measurements of an indicator crop in the greenhouse and on mature coffee in the field. Mulch reduced soil acidity; increased organic carbon, Kjeldahl nitrogen, exchangeable potassium, and available phosphorus; and decreased exchangeable calcium and manganese. It increased total pore space, free-draining pore space, and rate of rainfall acceptance in the top soil. Effects on the coffee were to increase phosphorus, potassium, and in some cases nitrogen in the leaf, but to reduce magnesium and calcium levels. Potassium and calcium levels were increased in feeder roots. In the ripe cherry, the phosphorus level was increased but nitrogen, calcium, and magnesium levels were reduced. The soil effects were reflected in increased growth of the indicator crop, and mulch improved the growth of the coffee tree in a year of seasonal drought.

East African Agr. and Forestry Res. Organ., Kikuyu, Kenya.

# PLANT MANAGEMENT

## Pasture and Haylands

See Also 49, 50, 52, 117, 125, 128, 131, 135, 160, 161, 176, 180, 181, 183, 186, 200, 231, 232, 268, 329.

210. Krenz, R. D. SEEDING CROPLAND TO GRASS. N. Dak. Farm Res. 23(9): 24-25. 1965.

Seeding cropland to permanent grass cover is not a general practice in North Dakota, but it is gaining in popularity in the western counties.

Grass seeding has been encouraged by Federal cost-sharing payments under the Agricultural Conservation Program (ACP) and under the Great Plains Conservation Program.

Since 1957, when the Great Plains Program was initiated, nearly 1,500 North Dakota farmers and ranchers have contracted to seed a total of 135,000 acres of cropland to permanent grass cover.

During 1963, a cooperative study was made of the economics of converting cropland to grass in southwest North Dakota. Information on their grass-seeding experiences was obtained from interviews of 116 participants in the Great Plains Program.

The replies of farmers indicated that most of them were seeding cropland to grass to increase and stabilize farm income and not because of cuts in wheat allotment, uncertainty of future farm programs, or because of soil erosion. By seeding grass they can

expand their livestock operations and reduce their cash crop operations. Of those interviewed, 79 percent believed such a shift would increase income and 92 percent believed thi shift would stabilize income.

N. Dak. Agr. Expt. Sta., N. Dak. State U., Fargo, N. Dak. 58103

211. Springfield, H. W. RATE AND SPACING IN SEEDING CRESTED WHEATGRASS IN NEW MEXICO. U.S. Forest Serv. Res. Note RM-42, 8 pp. 1965.

Crested wheatgrass stands in New Mexico reached an equilibrium with the environment within 5 to 8 years, regardless of rate of seeding or amount of drill row spacing. Herbage yields were essentially the same for the 2-, 4-, and 6-pound per acre seeding rates and for the 6-, 12-, and 18-inch row spacing in the fifth, sixth, and eighth years after seeding.

The number of plants per square foot in the eighth year after seeding was about the same, regardless of spacing or seeding rate.

These results suggest that drill row spacings are not critical, and that seeding rates below the usual 6-pound per acre rate may be used to cut down seed costs. The 2-pound rate may result in a slowly developing stand except under favorable conditions of soil preparation, seeding, and weather. The 4-pound rate, however, seemed worthy of trial.

Rocky Mountain Forest and Range Expt. Sta., FS, USDA, Fort Collins, Colo. 80521

212. Ukkelberg, H. G., Southwell, B. L., and Long, L. F. WINTER PASTURES FOR BEEF CATTLE ON HEAVY BLADEN AND ASSOCIATED SOILS OF THE SOUTHEAST. Ga. Agr. Expt. Sta. C. N.S. 47, 14 pp. 1965.

Areas of a tall fescue-ladino clover mixture, sod-seeded Abruzzi rye, sod-seeded Italian ryegrass, and volunteer crimson clover were developed into a system and were compared for a 4-year period as sources of winter grazing for commercial brood cows. The study was done on heavy Bladen and associated type soils which are slowly permeable, have a highly plastic subsoil, have excellent water holding capacity, but are difficult to manage. The fescue-ladino clover mixture furnished an average of 112, sod-seeded Abruzzi rye 87, sod-seeded ryegrass 69, and volunteer crimson clover 37 animal grazing days per acre. The average yield of dry forage (16 percent moisture) from these crops (as determined by clipped caged areas) was 3.8, 2.2, 1.8, and 1.2 tons per acre, respectively. In addition, the sod-seeded and crimson clover acres furnished summer pasture.

The average date that sufficient forage was available for grazing from these crops was November 20 for the fescue-ladino clover mixture, January 14 for sod-seeded Abruzzi rye, February 14 for sod-seeded ryegrass, and March 16 for volunteer crimson clover. Cows were fed good Coastal bermudagrass hay during the winter when grazing was not available.

Sod-seeding was done on Coastal bermudagrass or bahiagrass pasture, which pastures furnished summer grazing for the brood cows and their calves. Of these crops, 42 acres carried 52 cows and their calves from May to October.

The average acreage required to carry 52 brood cows year-round and their calves during the suckling period only was 84 acreas of 1.6 acres per cow. The cows weaned an 81 percent calf crop. The 169 calves weaned in the 4-year study had an average weaned weight of 432 pounds with a daily gain of 1.58 pounds from birth to weaning.

Ga. Agr. Expt. Sta., U. Ga. Col. Agr., Athens, Ga. 30601

213. High, J. W., Jr., Safley, L. M., Long, O. H., Duncan, H. R., and High, T. W., Jr.
COMBINATIONS OF ORCHARDGRASS, FESCUE, AND LADINO CLOVER, PAS-
TURES FOR PRODUCING YEARLING STEERS. Tenn. Agr. Expt. Sta. B. 388,
26 pp. 1964.

A study was conducted over a 5-year period (1953-57) to evaluate the following pas-
ture treatments for the production of yearling slaughter steers: (1) Orchardgrass-ladino
clover; (2) orchardgrass-fescue-ladino clover; (3) fescue-ladino clover; and (4) fescue-
ladino clover with 250 pounds of ammonium nitrate applied in five 50-pound increments
at 56-day intervals each year. Each treatment was in duplicate.

For the winter period, all treatments plus hay, ad libitum, produced about a 1.25-pound
gain per head per day. Grazing days and beef gain per acre averaged higher on fescue-
clover plus nitrogen than other pasture treatments.

During the summer grazing period, rate of grain and grazing days averaged highest
on orchardgrass-clover. Beef gain per acre was significantly less on the fescue-clover,
(treatment 3).

For the combined winter and summer period, rate of gain was significantly higher on
orchardgrass-clover (treatment 1) than on the others. There were significantly more
grazing days per acre on the nitrogen fertilized fescue-clover (treatment 4). Also, orchard-
grass-fescue-clover (treatment 2) provided significantly more days of grazing than treat-
ments 1 and 3. Gross returns per head and per acre were highest on treatment 1 and
lowest on treatment 4. Returns per head above hay and nitrogen costs were about the same
on treatments 1, 2, and 3; on a per-acre basis, treatment 2 was highest.

Pasture composition changed during the experiment. Fescue tended to crowd out the
clover in treatments 2, 3, and 4. Nitrogen accelerated the loss of clover in treatment 4.

Forage yields were determined on eight pasture treatments by clipping small plots
adjacent to the grazed area. Over the 5-year period 1953-57, the orchardgrass-clover
treatment produced the least forage (average of 1.85 tons per year), and the fescue-clover
nitrogen treatment the most (3.02 tons per year).

Forage yields obtained on the clipped plots and summer beef gains on the grazed areas
were used to calculate the pounds of forage required to produce 1 pound of beef gain.
The orchardgrass-clover mixture required the least amount of forage (16 pounds), and
the nitrogen-fertilized fescue-clover mixture the greatest amount (30 pounds) per pound of
gain.

U. Tenn., Agr. Expt. Sta., Knoxville, Tenn. 37901

214. Vicente-Chandler, J., Caro-Costas, R., Pearson, R. W., Abruna, F., Figarella, J.,
and Silva, S. THE INTENSIVE MANAGEMENT OF TROPICAL FORAGES IN
PUERTO RICO. U. Puerto Rico Agr. Expt. Sta. B. 187, 152 pp. 1964.

The world's greatest potential for forage, and hence for cattle production, lies in vast
areas of the Humid Tropics with year-round warm weather, high rainfall, and deep
porous soils.

Recommended practices include: Planting of high-yielding nutritious forages; control
of insects and diseases; heavy fertilization and liming; proper weed control and mowing;
cutting or grazing at proper intervals and heights; intensive systems of grazing;
preservation of forage for use during seasons of slow growth; proper management to
equalize seasonal variations in growth; and proper feeding and care of cattle.

In the Humid Region of Puerto Rico, or where irrigation is available, Napier grass should be preferred for cut-feeding or as silage, and Guineagrass, Pangolagrass, or Napiergrass for grazing. Tropical kudzu-molassesgrass pastures are best for very steep, hard-to-reach lands. Guineagrass is best for the Semiarid Region.

Up to 2 tons of 14-4-10 or similar fertilizer should be applied per acre yearly in six applications to cut grasses, and up to 1 ton of fertilizer in four applications to pastures in the Humid Region or under irrigation in the Semiarid Region. Kudzu-molassesgrass pastures should receive 100 pounds of potassium and 40 pounds of $P_2 O_5$ per acre yearly. Soils should be limed to about pH 5.5, and thereafter 1 ton of limestone should be applied for each ton of fertilizer.

Forages for cutting should be harvested every 50 to 60 days while pastures should be grazed every 20 to 30 days. Guineagrass and molassesgrass and tropical kudzu should be grazed close to the ground, but Paragrass, Pangolagrass, and Napiergrass may be cut rather closely.

Forages should be managed as intensively as possible to make full use of their high productive capacity.

U. Puerto Rico., Agr. Expt. Sta., Rio Predias, Puerto Rico. 00928

215. High, T. W., Jr., Chapman, E. J., Whittenberg, B. L., and High, J. W., Jr. FESCUE PASTURES, UNDER DIFFERENT MANAGEMENT SYSTEMS, AND ORCHARD-GRASS-CLOVER FOR YEARLING SLAUGHTER STEER PRODUCTION. Tenn. Agr. Expt. Sta. B. 385, 20 pp. 1965.

Grazing trials were conducted during 3 years (1959-62) to compare the beef production on fescue pastures under three systems of management and to compare these fescue treatments with an orchardgrass-ladino pasture.

Treatments were: (1) Fescue clipped 4 to 6 inches when needed to remove seed heads; (2) fescue clipped to 2 to 4 inches when grass averaged 6 to 8 inches in height; (3) fescue topseeded with 20 pounds of lespedeza per acre; and (4) orchardgrass managed as in (1).

Pastures were stocked with steer calves about November 1 each year, and they were grazed constantly until about September 1 the following year. Steers were then removed and finished to USDA Good grade in dry-lot. The authors concluded that:

1. Winter daily gains were slightly higher on the fescue treatments than on orchardgrass, but differences were not significant (P > 0.05).
2. In only 1 year did close-clipping of fescue (treatments 2 and 3) increase steer daily gains. That year clovers thrived in the close-clipped pastures.
3. Lespedeza was successfully established by lightly disking the sod and then broadcasting the seed. Gains were increased during the midsummer months but were not significantly greater for the entire season.
4. Summer daily gains of cattle on the orchardgrass-ladino clover treatment were significantly greater (P > 0.05) than those of cattle on the three fescue treatments. Also, carrying capacity was higher and steers averaged one-third grade higher.
5. The fescue sods remained very dense during the experiment while the orchardgrass thinned out over a 7-year period.
6. All cattle performed well in the feedlot during the 100 days. The orchardgrass steers averaged 12 days less in the feedlot than the fescue steers and returned more dollars per head for the entire period.

U. Tenn., Agr. Expt. Sta., Knoxville, Tenn. 37901

216. Hobbs, C. S., High, T. W., Jr., and Dyer, I., Jr. ORCHARDGRASS AND FESCUE
    PASTURES FOR PRODUCING YEARLING SLAUGHTER STEERS. Tenn. Agr. Expt.
    Sta. B. 386, 22 pp. 1965.

Orchardgrass and fescue, alone and in combination with ladino clover and at two rates
of nitrogen fertilization, were compared for 4 years, 1956-59, for producing yearling
slaughter cattle. The authors concluded that:

1. Orchardgrass-clover pastures, with and without nitrogen, produced significantly
   higher daily gains during the summer grazing season than straight orchardgrass or
   fescue with nitrogen, and fescue-clover with and without nitrogen. Cattle that grazed
   orchardgrass-clover pastures graded higher at the end of the grazing season.
2. Clover content of the fescue-clover pastures declined from about 40 percent of the
   total forage the first year (1956) to 1 percent the fourth year (1959). For orchard-
   grass-clover pastures, clover declined from 40 to 50 percent in 1956 to 20 to 25 per-
   cent in 1959. Orchard-grass-clover pastures produced higher daily gains and
   higher grading cattle all year round than the straight fescue, fescue-clover, or
   straight orchardgrass pastures, all of which produced similar daily gains.
3. Fescue pastures produced significantly higher daily gains (P<0.05) during the
   winter than orchardgrass pastures regardless of clover content or nitrogen fertili-
   zation. Fescue pastures carried more head per acre both summer and winter.
4. Adding 450 pounds of ammonium nitrate annually to straight fescue and orchard-
   grass and 225 pounds annually to fescue-clover and orchardgrass-clover pastures
   was unprofitable.

U. Tenn., Agr. Expt. Sta., Knoxville, Tenn. 37901

217. Carpenter, S. OAT GRAZING AND COASTAL BERMUDA HAY COMPARED WITH
    SORGO SILAGE AND ALFALFA HAY. Tex. Agr. Expt. Sta. Prog. Rpt. PR-2359,
    4 pp. 1965.

Ten Jersey cows averaged 2.41 pounds more milk per cow per day when fed Coastal
Bermuda hay and grazed on green oats than when fed alfalfa hay and sorgo silage.
The additional 2.41 pounds of milk produced daily, plus 13.5 cents saved on feed cost,
gave a value of 27.3 cents for each 1-1/4 hours of daily grazing.
Gross income per acre was $57.30. Seed, fertilizer, and labor costs amounted to
$25.30 leaving a net of $32.00 per acre. Each $1.00 spent to grow the oat crop gave $2.27
in gross returns.

Tex. A&M U., Tex. Agr. Expt. sta., College Station, Tex. 77843

218. Wicks, G. A., Fenster, C. R., and Burnside, O. C. CHEMICAL CONTROL OF DOWNY
    BROME IN GRASSLANDS OF WESTERN NEBRASKA. Weeds 13(3): 202-204. July
    1965.

The most successful herbicides for control of downy brome (Bromus tectorum L.) in
grassland were: Amitrole; atrazine; propazine; and simazine. More consistent downy
brome control was obtained with atrazine than the other s-triazines. Amitrole improved
postemergence control of the s-triazines in the tillering stage. Intermediate wheatgrass
(Agropyron intermedium (Host.) Beauv.), crested wheat grass (Agropyron cristatum L.
Gaertn.), western wheatgrass (Agropyron smithii Rydb.), blue grama (Bouteloua gracilis
(H. B. K.) Lag.), and sedge (Carex spp.) appeared to be more sensitive to most s-triazines

than needle-and-thread (Stipa comata Trin. & Rupr.) and sand dropseed (Sporobolus cryptandrus Torr.). Sand dropseed was extremely tolerant.

North Platte Agr. Expt. Sta., North Platte, Nebr. 69101

219. Albert, W. B. CONTROL OF LITTLE BARLEY IN COASTAL BERMUDAGRASS WITH ATRAZINE AND PARAQUAT. Weeds 13(4): 375-376. Oct. 1965.

Treatment of little barley (Hordeum pusillum Nutt.) at early-tillering stages with 0.25 to 0.5 lb./acre paraquat, surfactant gave satisfactory to complete control of little barley and other annual weed species. Except under unfavorable seasonal conditions, atrazine also gave good control of little barley but was ineffective against other established weed species. Coastal bermudagrass (Cynodon dactylon (L.) Pers.) was not injured by atrazine and only temporarily by paraquat.

Clemson U., Clemson, S.C. 29631

220. Rogers, W. B., Moberly, H. D., and Williams, W. F. PRODUCTION AND PRODUCTION REQUIREMENTS, COSTS AND EXPECTED RETURNS FOR MIDLAND BERMUDAGRASS--HIGH PLAINS OF TEXAS. Tex. Agr. Expt. Sta. MP-765, 42 pp. 1965.

Negative returns were realized the first year Midland Bermuda was grown, due to the time required to obtain solid stands and high factor costs. The grass can be grazed lightly the first year if it is planted early in the season.
Midland Bermuda establishment was economically feasible on west Texas farms. Under the assumptions of this problem, approximately $300.00 over specified expenses was realized from an acre of Midland Bermuda sprigs at $0.50 per bushel.
Should a producer choose to graze his grass and sell sprigs, approximately $280.00 per acre would be realized from the firm's resources.
Producers who combine several enterprises, into one which allows sprig selling, grazing, and hay can have a net return of $200.00 over specified expenses. Returns over specified expenses amounted to only $14.55 per acre when Midland Bermuda was utilized for "grazing only."
Despite the low net returns from grazing, several distinct advantages of the "grazing only" enterprise were cited. Much of the Midland Bermuda was grown on relatively poor quality lands, including playa lake beds, lands with considerable slope, and shallow soil over rocks. Twenty-four AUM's often can be grazed under proper management practices and available labor frequently can be used more efficiently by having an alternative enterprise. On these lands, income derived may be greater through "grazing only" than for any other alternative enterprise.

Tex. A&M U., Tex. Agr. Expt. Sta., College Station, Tex. 77843

## Rangelands

See Also 21, 210, 299, 300, 302.

221. Jameson, D. A. PHENOLOGY OF GRASSES OF THE NORTHERN ARIZONA PINYON-JUNIPER TYPE. U.S. Forest Serv. Res. Note RM-47, 8 pp. 1964.

With a good mixture of grasses, a pinyon-juniper range should supply ample green forage from April 1 to September 30 and some green feed all winter. Phenology and height

growth of several important grasses in the pinyon-juniper type near Flagstaff, Ariz., were observed from 1957-60. Cool-season grasses reached peak height between May 18 and June 23 and remained partly green all year. Warm-season grasses were green only during spring, summer, and fall and reached peak heights between September 11 and September 21.

The amount of growth of each species was highly variable and was determined mostly by the precipitation during, or a month or two before, the period of most active growth of each species. The dates at which certain growth periods occur, on the other hand, were orderly and fairly predictable.

Grazing systems should be designed to allow occasional rest for both cool- and warm-season grasses during their growth periods. The following three periods should be recognized: "Summer", July 10 to October 15; "winter", October 15 to April 10; and "spring", April 10 to July 10. Because of differences in time of peak development of important grasses, forage production measurements should be taken in June for cool-season species and in Steptember for warm-season species. For most of the pinyon-juniper type, cool-season grasses need more protection than warm-season grasses.

Rocky Mountain Forest and Range Expt. Sta., FS, USDA, Fort Collins, Colo. 80521

222. Cook, C. W. GRASS SEEDLING RESPONSE TO HALOGETON COMPETITION. J Range Mangt. 18(6): 317-321. Nov. 1965.

A study was conducted on semidesert areas in northern Utah to determine the competitive effect of halogeton with grass seedlings.

During each of 4 years--1957, 1958, 1960, and 1961--a 20-acre area was summer fallowed and seeded to crested, intermediate, tall, and pubescent wheatgrasses and Russian wildrye grass. One half of each seeding plot was treated with 2,4-D during June to eliminate competition of halogeton with the seedlings. Portions of each plot were treated as follows: (1) Sprayed the first growing season; (2) sprayed for 2 consecutive growing seasons; and (3) unsprayed.

Seedling survival for all grass species was greater on sprayed plots. These differences were more pronounced for tall, pubescent, and intermediate wheatgrass than for crested wheatgrass or Russian wildrye.

Herbage yields at the end of the third growing season were significantly higher for grasses on sprayed plots, and yields of grasses from plots sprayed for 2 consecutive years were higher than from plots sprayed only during the first growing season. Crested wheatgrass and Russian wildrye produced more herbage on unsprayed plots than did the other grasses studies.

Crested wheatgrass and Russian wildrye were better adapted to low rainfall areas and competed more effectively with halogeton than tall, pubescent, or intermediate wheatgrasses.

Control of halogeton during the first growing season aided grasses in producing relatively deep root systems, but when control was extended for 2 growing seasons even deeper root systems resulted.

In most cases, soil moisture was higher in sprayed plots. These differences were present during the third year even though halogeton was controlled only for the first 2 years.

Utah State U., Logan, Utah. 84321

223. McKell, C. M., Brown, V. W., Walker, C. F., and Love, R. M. SPECIES COMPOSI-
TION CHANGES IN SEEDED GRASSLANDS CONVERTED FROM CHAPARRAL.
J. Range Mangt. 18(6): 321-326. Nov. 1965.

Vegetation analyses of two brush-to-grass conversion projects were conducted for
several years following seeding. The results of these analyses provided valuable informa-
tion on the persistence or decline of various species. Species composition changes were
studied for 9 years at the Tule Springs Range, San Diego County, Calif., and for 6 years
at the Manley Demonstration Range in Tulare County.

The changes in species composition consisted primarily of an increase in such peren-
nial grasses as hardinggrass and smilo at Tule Springs Range and these two grasses plus
crested wheatgrass at the Manley Demonstration Range. At both locations, several peren-
nial grass species which made average or better initial stands were almost totally missing
from the pastures at the end of the study. Of the seeded annual grasses, ryegrass decreased
rapidly from the stand in contrast to a large increase in soft chess.

In all pastures, there was a substantial increase in nonseeded annual grasses and
weeds. The annual species showed the greatest fluctuation from year to year in relation
to the amount of precipitation.

Mortality of perennial grasses was high in dry years, but many grasses survived
even though a portion of the crown area died. Long-term stability and persistence of
several perennial grass species were evident from the records.

U. Calif., Riverside, Calif. 92502

224. Cable, D. R. DAMAGE TO MESQUITE, LEHMANN LOVEGRASS, AND BLACK GRAMA
BY A HOT JUNE FIRE. J. Range Mangt. 18(6): 326-329. Nov. 1965.

The rate and amount of sprouting by velvet mesquite, Lehmann lovegrass, and black
grama were measured during the first growing season following an accidental fire. Un-
burned portions of the area dominated by Lehmann lovegrass contained 4,480 lb./acre
(air-dry) of herbaceous fuel compared with 2,200 lb. on the black grama area. Heat pro-
duced was proportional to available fuel. This was reflected in significant differences in
fire effects on the two parts of the burn. Results of the measurements were:

1. The fire killed 25 percent of the mesquite trees on the lovegrass area, compared
   with 8 percent on the black grama area. A higher proportion of smaller trees were
   killed than of larger trees.
2. Of the mesquite trees not killed by the fire, only 17 percent of those on the lovegrass
   area produced crown sprouts, compared with 39 percent on the black grama area.
   On trees that sprouted, crown recovery the first year was twice as high on the black
   grama area (33 percent) as that on the lovegrass area (16 percent).
3. On both areas, more crown sprouts were produced on trees whose basal stem
   diameter was greater than 2 inches than on smaller trees. The smaller trees
   sprouted more from basal stem buds.
4. The proportion of trees sprouting from the base was about the same on both areas and
   was much higher than the proportion sprouting from the crown.
5. Only 10 percent of the original black grama plants, and less than 2 percent of the
   lovegrass plants, sprouted. Black grama plants started sprouting sooner after the
   fire and continued sprouting longer than did lovegrass plants.

Many new Lehmann lovegrass seedlings became established on both areas the first
growing season following the fire. Most of these seedlings matured seed the first year.

Rocky Mountain Forest and Range Expt. Sta., FS, USDA, Tucson, Ariz. 85721

225. Anderson, K. L. TIME OF BURNING AS IT AFFECTS SOIL MOISTURE IN AN
ORDINARY UPLAND BLUESTEM PRAIRIE IN THE FLINT HILLS. J. Range Mangt.
18(6): 311-316. Nov. 1965

Range burning was shown to reduce significantly the levels of soil moisture at all
depths. The reduction was greater following early burning than late burning and was greater
in deeper soil layers than in upper ones. The implications were clear. Burn no more than
is necessary for good range management and good livestock husbandry. If burning is
practiced, do it in the late spring rather than earlier, recognizing that soil moisture
levels, and hence herbage yield, will be reduced by burning. The earlier one burns, the
less herbage he will have for harvest by livestock.

Kans. State U., Manhattan, Kans. 66504

226. Buffington, L. C., and Herbel, C. H. VEGETATIONAL CHANGES ON A SEMIDESERT
GRASSLAND RANGE. Ecol. Monog. 35: 139-164. Spring 1965.

General Land Office Survey notes made in 1858 for the 144,475 acres in the study area
on the Jornada Experimental Range were analyzed and compared with vegetation maps on
ocular reconnaissance range surveys for the years 1915, 1928, and 1963. Comparisons
were also made among the reconnaissance surveys. Acreages covered by mesquite,
creosotebush, tarbush, and their various combinations were studied on the basis of the
soil types on which they occurred.

In 1858, good grass was present on more than 90 percent of the study area. By 1963,
less than 25 percent of the area had good grass. Mesquite was present on all soil types.
However, the main invasion of mesquite was on sandy soils.

Only slight mesquite invasion took place on soils having gypsum in their profile.
Creosotebush was not found on the gypsiferous soils. The area dominated by creosotebush
increased from about a section in 1858 to over 12,000 acres in 1963.

On the southeastern part of the study area, creosotebush was present in some areas
in 1858; however, a good stand of grass was also present. With selective grazing of
grasses by livestock and recurring drought, the equilibrium on those drier sites between
creosotebush and grass was shifted in favor of brush.

Tarbush was present on all soils where creosotebush was growing, but creosotebush
was not present on all areas where tarbush dominated.

The climate has not changed enough to be the major factor responsible for the rapid
increase of brush species. Periodic droughts have been a factor in reducing grass com-
petition so that brush species can become established. Rodent and rabbit activity was a
secondary factor in the spread of brush. Seed dispersal, accompanied by heavy grazing
and periodic droughts, appeared to be the major factor affecting the rapid increase of
shrubs.

CRD, ARS, USDA, Las Cruces, N. Mex. 88001

227. Dwyer, D. D. , and Hutcheson, H. L. GROWTH RATE OF FOUR RANGE GRASSES
IN NORTH CENTRAL OKLAHOMA. Okla. Agr. Expt. Sta. B. B-638, 15 pp. 1965.

Growth and development of the four major grass species in eastern Oklahoma prairies
were studied from March 11 to October 28, 1961. The study area was essentially an un-
disturbed, climax prairie. Little bluestem was the dominant species  and big bluestem and

indiangrass were secondary. Forage production on the area was 4,077 pounds of air-dry material per acre and mulch accumulation was 4,375 pounds per acre.

Developmental growth of little bluestem, big bluestem, and indiangrass was very similar. Switchgrass emerged with the other species and grew at the same rate until May 15. After that time, switchgrass grew faster and longer, still increasing in height when the other species' growth rate leveled off in mid-June.

From mid-June, size increase in the vegetative portion of little bluestem, big bluestem and indiangrass was small. Switchgrass height continued to increase from April 1 to September 1.

Little bluestem and big bluestem had nearly identical height and growth trends. However, the leaf blades of big bluestem were both longer and wider. Indiangrass leaves were longer and wider and the plants grew taller than either big or little bluestem. Indiangrass yielded 27 percent of the total forage, although it made up only 16 percent of the grass stand.

The big bluestem produced a lower percentage of seedstalks than the other three species. Vegetative growth of little bluestem, big bluestem, and indiangrass was approximately 80 percent complete by mid-June.

Inflorescence formation in little bluestem, big bluestem, and indiangrass was initiated in late August. However, in switchgrass they had matured in all plants by this time. Leaves of switchgrass reached their maximum length by June 16 while those of the other species took until late July.

The decline in average measurements of seed stalk height and leaf width and length in September and October, indicated that big bluestem deteriorated the earliest of all species, but its seedstalks persisted longer.

Okla. State U. Expt. Sta., Stillwater, Okla. 74075


228. Hughes, E. E. BASAL AND STUMP SPRAYS FOR CONTROL OF SALTCEDAR. Weeds 13(4): 339-340. Oct. 1965.

Studies in New Mexico showed basal and stump applicatons of ester and oil-soluble amine formulations of silvex to be effective for control of saltcedar (Tamarix pentandra Pall.). Trees with trunks 2 inches or larger in diameter were harder to kill than smaller trees and retreatment was often needed. Spraying the lower 2 feet was no more effective than spraying the lower foot. Cutting the larger trees and spraying the stump increased effectiveness.

CRD, ARS, USDA, Los Lunas, N. Mex. 87031

229. Gray, J. R., Stubblefield, T. M., and Roberts, N. K. ECONOMIC ASPECTS OF RANGE IMPROVEMENTS IN THE SOUTHWEST. N. Mex. Agr. Expt. Sta. B. 498 (Western Region P.), 47 pp. 1965.

A study was made of the costs and returns from seven common range improvements in six areas of New Mexico, Arizona, and Utah. Budgets were prepared for 26 representative ranch units in the 6 areas. The representative ranches varied in size from 95 to 1,300 animal units. Net ranch incomes varied from $3.08 to $40.78 per animal unit.

Calf crops throughout the six areas varied from 74.8 to 88.2 percent Death loss on the cattle ranches varied from 1.4 to 7.0 percent. Calf weights varied from 375 to 450 pounds. Lamb crops varied from 78 to 83 percent, death losses from 2.2 to 7.9 percent, and lamb weights from 68 to 75 pounds.

Artificial reseeding cost from $12.00 to $25.48 per acre in two areas.

Controlling competitive shrubs consisted of: Root cutting and removal of cactus; hand grubbing of mesquite; bulldozing or chaining of velvet mesquite; and cutting, chaining, and bulldozing pinyon and juniper. Average costs per acre for cutting and chaining pinyon and juniper varied from $2.06 to $14.00 per acre. Most brush control programs cost from $3.00 to $6.00 per acre.

Average costs per foot of drilled stock wells ranged from $5.32 to $12.30. Average depth drilled ranged from 226 to 300 feet. Shallow well units of about 100-foot depth with a powerpump jack and storage facilities cost $14.92 per foot drilled. A 250-foot well with reciprocating type pumping unit, including a storage facility, cost $9.90 per foot drilled.

Steel-rim storage tanks varied in size from 12,000-gallon capacity to 381 cubic yards. The average cost in the six areas varied from $6.86 to $13.90 per cubic yard.

The average cost of earthmoving for earthen stock reservoirs varied from 18.7 to 24.3 cents per cubic yard of earth moved.

Average plastic pipeline costs varied from 11.2 to 30.8 cents per linear foot. Average distances of pipe installed were from about 8,000 to over 17,000 feet in the different areas.

Ranchers who built barbed-wire fences paid from $397 to $1,085 per mile.

Agricultural Conservation Program (ACP) payments were highest for deferred grazing and range reseeding and lowest for well developments. Most ACP payments varied from 30 to 50 percent of the total cost.

Most medium-sized and large ranch units could pay off the costs of range improvements with 5 percent or less of the net incomes in 10 to 15 years. Ranches in poor condition and small ranches would have difficulty in paying for range improvements in less than 15 years unless the ranch operators were willing to invest from 20 to 40 percent of their net incomes in range improvement over the 15-year period.

Tables and charts.

Agr. Expt. Sta., N. Mex. State U., State College, N. Mex. 88070

230. Gray, J. R. ECONOMIC ASPECTS OF RANGE IMPROVEMENTS. J. Soil and Water Conserv. 20(3): 106-109. 1965.

The common range improvements being adopted in southern New Mexico are: Vegetative control measures, water developments (livestock wells, steel-rim storage tanks, earthen stock reservoirs, and plastic pipelines); and fence construction. The costs of range improvements varied widely within, as well as between, the two areas studied. Generally, costs were higher in southwestern New Mexico than in southeastern New Mexico.

There were significant or highly significant statistical relationships between size of a practice and its cost. The increased returns per acre necessary to liquidate the initial costs and maintenance charges for a variety of different kinds of range improvements on cattle ranches rated in the poor condition class were modest.

A technique was discussed for calculating the annual returns necessary to pay for range improvements over their useful life. Data from southern New Mexico were given on the costs of various improvements.

N. Mex. State U., University Park, N. Mex. 88070

# Plant Materials

231.  Gangstad, E. O.  DESOTO GRASS.  Hoblitzelle Agr. Lab. B. 22, 11 pp.  1965.

DeSoto grass, developed at Renner, Tex., is a new variety of perennial forage sorghum well adapted to supply succulent green forage. It will thrive wherever Johnsongrass grows.

The grass has good persistence, palatability, and seed and forage yield, as compared to other perennial sorghums, under recommended cultural practices.

The seed have excellent vigor of germination and ability to reseed. DeSoto grass was not recommended for planting in crop rotations because of the persistence of hard seed. Total germination was 70 to 85 percent with 10 to 15 percent hard seed.

Best results were obtained by planting in rows 36 to 40 inches apart, at a rate of 5 to 8 pounds of seed per acre, and at a depth of $1\frac{1}{2}$ to $2\frac{1}{2}$ inches on a well prepared seedbed. Planting could be made February through September, if moisture was sufficient for germination and seedling growth. Early spring planting was recommended.

Grazing should not be attempted until the plants are $2\frac{1}{2}$ to $3\frac{1}{2}$ feet tall. This grass may be stocked at relatively high rates, three to five animals per acre, if the cattle are removed when the plants are grazed down to a stubble of 12 to 15 inches. Close grazing or clipping reduced the stand of grass. With proper management it was a persistent perennial.

Fertilizer requirement of DeSoto grass was best determined by actual soil test, but on the blackland soil, fertilization with 50 pounds per acre of nitrogen in April and June and 50 pounds of phosphorus in either April or September gave excellent production.

Hoblitzelle Agr. Lab., Texas Res. Found, Renner, Tex.  75079

232.  Rhoades, E. D., and Lippert, R. D.  GRASS CAN SURVIVE EVEN IF IT'S FLOODED.
    Kansas Farmer-Stockman 78(1): 12.  Jan. 1965.

Research at Chickasha, Okla., during 1961-62 showed that numerous grasses were suitable for use in the flood storage area of detention reservoirs. However, as the depth and duration of flooding increased, individual plants of a given species were killed more readily. Some grasses that survived the early spring floodings were severely damaged or killed by an equivalent duration of deep flooding.

The flooding tolerance of several good quality range and pasture grasses was found to vary from a mild flooding tolerance of only a few days up to a very strong flooding tolerance of 20 days or more during the midspring season.

SWCRD, ARS, USDA, Chickasha, Okla.  73018

233.  Scott, R. F.  PROBLEMS OF MULTIFLORA ROSE SPREAD AND CONTROL.  Trans.
    North Amer. Wildlife and Nat. Resource Conf. 30: 360-378.  1965.

Information was provided about the spread and control of multiflora rose (Rosa multiflora Thunb.). Some of the issues raised by the multiflora controversy were examined, and perspectives for resolving them were suggested. The central thesis of the report was that multiflora has developed into an appreciable nuisance over much of its introduced range; and that conservation agencies have been reluctant to recognize or admit this, and embarrassingly slow to agree on how to cope with this development. It was not suggested

that every planting has become a nuisance to every landowner, but that this was an increasingly common experience throughout the areas in which it has been planted in quantity and grown successfully.

Patuxent Wildlife Res. Cent., Bur. Sport Fisheries and Wildlife, Laurel, Md. 20810

234. Lee, W. O. HERBICIDES IN SEEDBED PREPARATION FOR THE ESTABLISHMENT OF GRASS SEED FIELDS. Weeds 13(4): 293-297. Oct. 1965.

Seedbed preparation was completed about October 15, just before the fall rains. Four herbicide treatments--paraquat, diquat, IPC + 2,4-D, and amitrole-T--were successfully applied before January 15 for control of weeds and volunteer crop plants. Grasses for seed production were sown in March without disturbing the soil. An application of paraquat at seeding time greatly increased subsequent seed yields. Little additional germination of contaminating weed grasses occurred after the grasses were planted, and they became established rapidly. By the following October, most species could be treated with diuron to control winter annual weeds. Where weeds were thus effectively controlled during the establishment period, excellent stands resulted which produced high yields of weed-free seed in the first year of seed production.

CRD, ARS, USDA, Corvallis, Oreg. 97331

# Woodlands

See Also 8, 10, 15, 19, 20, 123, 128, 132, 134, 202, 221, 288, 301, 306, 321.

235. Jones, E. P., and Bennett, F. A. TEN YEARS OF TIMBER MANAGEMENT IN THE MIDDLE COASTAL PLAIN OF GEORGIA. U.S. Forest Serv. Res. Paper SE-16, 17 pp. Feb. 1965.

The pilot forest on the George Walton Experimental Forest represents the medium-size forest ownership in the middle coastal plain of Georgia. This 2,200-acre forest of slash and longleaf pine has been under planned management for 10 years. Gross earnings have been $7.03 per acre per year, with an annual cost of $1.15 per acre.

From the first 10 years of management on the pilot forest, the following conclusions were drawn:
1. The medium-size forest ownership of 2,000 to 2,500 acres could be operated as an independent and self-sustaining unit in the middle coastal plain of Georgia.
2. Given effective fire protection on understocked areas, slash pine stands readily expanded in area and density through the regenerative and fast growth habits of the species.
3. In spite of intensive management, acreage actually growing merchantable timber volumes on the average forest holding will probably not increase beyond certain limits..
4. Average cordwood growth rates of 10 percent or better were possible on young, understocked longleaf-slash pine stands. Sawtimber growth rates of 15 to 20 percent were realized.
5. Sawtimber ingrowth in young, lightly stocked stands of longleaf-slash pine was such that the original stocking was virtually doubled over a 10-year period while most of the original volume was harvested.
6. Excluding interest on the investment, a return of 10 percent was possible.

Southeastern Expt. Sta., FS, USDA, Asheville, N. C. 28802

236. Winget, C. H., and Kozlowski, T. T. YELLOW BIRCH GERMINATION AND SEED-
     LINGS GROWTH. Forest Sci. 11(4): 386-392. Dec. 1965.

Germination and seedling growth of yellow birch were compared for various types of
naturally-occurring seedbeds in germination cabinet and greenhouse conditions. Peak rates
of germination were reached earlier on moist H layer humus and decayed hemlock wood
seedbeds than on mineral soil seedbeds, but total germination was similar on all. Much
more rapid height growth and much greater dry weight increment were obtained on seed-
beds of exposed, intact humus over mineral soil profiles than on sandy loam, silty mineral
soil, or decayed wood. Drought resistance of established seedlings was greater on humus
over mineral soil seedbeds than on any other type tested, presumably because of better
root development.

Canada Dept. Foresteries, Forest Res. Bur., Sillery, Quebec, Canada.

237. Gilmore, A. R., and Geyer, W. A. EARLY PRUNING OF LOBLOLLY PINE: EFFECTS
     ON WEEKLY GROWTH AT VARIOUS LOCATIONS ON THE STEM. Trans. Ill.
     State Acad. Sci. 58(1): 50-55. 1965.

Loblolly pine was pruned to 20, 40, and 60 percent, and the weekly radial growth was
determined at various locations on the stem.
    Results the first year following pruning were: Trees varied considerably in their rates
of stem growth; pruning delayed growth initiation and reduced growth rate with the most
drastic pruning having the greatest effect; growth was greatest in the crown and decreased
as distance below the live crown increased; and height growth was not affected by intensity
of pruning.

U. Ill., Urbana, Ill. 61803

238. McDonald, P. M. LOGGING COSTS AND PRODUCTION RATES FOR THE GROUP-
     SELECTION CUTTING METHOD. U.S. Forest Serv. Res. Note PSW-59, 3 pp.
     1965.

Young-growth, mixed-conifer stands were logged by a group-selection method designed
to create openings 30, 60, and 90 feet in diameter. Total costs for felling, limbering, buck-
ing, and skidding on these openings ranged from $7.04 to $7.99 per thousand board feet.
Cost differences between openings were not statistically significant. Logging costs for group
selection compared favorable with those previously reported for seed-tree and selection
harvest cuts--$8.20 and $8.39, respectively.

Pacific Northwest Forest and Range Expt. Sta., FS, USDA, Berkeley, Calif. 94701

239. Halls, L. K., and Crawford, H. S. VEGETATION RESPONSE TO AN OZARK WOOD-
     LAND SPRAYING. J. Range Mangt. 18(6): 338-340. Nov. 1965.

Aerial spraying of an Ozark woodland with 2,4,5-T temporarily increased yields of
grasses preferred by cattle. Reinvasion of woody plants and heavy grazing by cattle con-
tributed to a subsequent decline in yields of grass. The invading shrubs included many
species preferred by deer.

Southern Forest Expt. Sta., FS, USDA, Nacogdoches, Tex. 75961

240.  Wang, J. K.  MECHANICAL COFFEE HARVESTING: I.  Trans. ASAE 8(3): 400–402, 405.  1965.

Those physical properties of coffee cherries, which are important to the design of a mechanical harvester, were determined. Coffee cherries were about twice as difficult to harvest, by vibratory means, as olives.

A method was devised to yield an estimation of the natural frequency of a system consisting of a coffee cherry and its peduncle. In essence, this method estimated the upper and lower limits for the natural frequency. The natural frequency for mature coffee cherries was estimated at 7,000 to 9,000 cycles per minute. The natural frequency of immature coffee cherries was much higher.

The differences between mature and immature coffee cherries on their removal-force-to-weight ratios and natural frequencies indicated the possibility of selective harvesting of the mature cherries.

An experimental harvester with frequencies of 0 to 3,000 c.p.m., was constructed. 3,000 c.p.m. was about one-third to three-seventh of the estimated natural frequency for mature coffee cherries and was below one-fifth of the natural frequency of immature cherries.

Coffee cherries were harvested successfully with this experimental machine. Eighty-five percent selectivity was achieved under controlled conditions. This means 85 out of 100 pounds of coffee cherries harvested were mature. The percentage compared rather favorably with hand picking.

U. Hawaii, Honolulu. Hawaii.  96822

241.  Wormer, T. M., and Firman, I. D.  CONTROL OF CRINKLE-LEAF OF COFFEE IN KENYA.  Expt. Agr. 1(1): 1–10.  1965.

Crinkle-leaf is an abnormal condition of the leaf of coffee in Kenya, the cause of which is unknown. Preliminary observations showed that its symptoms were suppressed by spraying with captan and experiments were carried out to investigate whether this material would provide an economic control. Spraying at the rate of 4 lb. per acre, when symptoms of the condition first appeared, gave good control but lower quantities were less effective. Means of predicting the severity of the condition have not yet been evolved, and the spray program must be adjusted each season to meet the local conditions. The spraying of nurseries and young suckers was recommended as soon as early symptoms were noted. The spraying of large areas of mature coffee required a careful assessment of the possible economic advantages. Susceptibility to crinkle-leaf was found to differ between cultivars.

Coffee Res. Sta., Ruiru, Kenya.

## Fruit and Nut Crops

See Also 35, 46. 118, 124, 201. 328.

242.  Miller, S. R.  GROWTH INHIBITION PRODUCED BY LEAF EXTRACTS FROM SIZE-CONTROLLING APPLE ROOTSTOCKS.  Canad. J. Plant Sci. 45(6): 519–524. Nov. 1965.

Dilute alkali extracts of leaves from size-controlling rootstocks inhibited the growth of stratified apple seeds. Correlation coefficients of –0.9140 and –0.7292 existed between the vigor of the rootstocks and the respective growth of apple and wheat seedlings in the

leaf extracts. The crude extract was chromatographed in isopropanol:ammonia:water (10:1:1). Two zones of growth inhibition were detected using a watercress bioassay. These zones were at 0 to 0.1 and 0.4 to 0.5 $R_f$ units. The amount of growth made by the water-cress was in the same ratio as the known vigor of the rootstocks M.II, M.VII, and M.IX. Measurement of the rate of indoleacetic acid oxidation showed that the material at an $R_f$ 0.4 to 0.6 affected IAA breakdown. The more dwarfing rootstocks stimulated the oxidation of IAA. The significance of the results was discussed in relation to the dwarfing of apple rootstocks.

Expt. Farm, Canada Dept. Agr., Smithfield, Ontario, Canada.

243. White, R. G., Young, L. C., and Collins, W. B. THE INFLUENCE OF ANTONOVKA FRAMEWORK ON THE GROWTH AND PRODUCTIVITY OF APPLE VARIETIES. Canad. J. Plant Sci. 45(5): 455-460. Sept. 1965.

Nine apple varieties topworked to the winterhardy variety Antonovka made better trees than the same varieties grown on their own trunks. Initial growth seemed more rapid, tree conformation was superior, and cumulative yields were higher on the top-worked trees. Tender varieties in both groups were either winterkilled or sustained considerable damage, but those on the Antonovka framework, if injured, generally made the best recovery.

Res. Sta., Canada Dept. Agr., Fredericton, New Brunswick, Canada.

244. Taper, C. D., and Murray, H. R. EFFECTS OF CERTAIN INTERSTOCK--ROOT-STOCK COMBINATIONS ON THE PERFORMANCE OF McINTOSH AND CORTLAND APPLES. Canad. J. Plant Sci. 45(4): 353-355. July 1965.

The effects of rootstock and interstock on the performance of scion apple varieties McIntosh and Cortland were studied over a 17-year period. The clonal interstocks Hibernal and Malus robusta 5, the seedling rootstocks Anis, Antonovka, and McIntosh, and the clonal rootstock M. robusta 5 were used in all possible combinations.
The yields of both scion varieties were significantly greater on Hibernal interstock than on M. robusta 5 interstock. Scion rootstock interaction was also significant, since McIntosh yielded better than Cortland on Anis rootstock, whereas Cortland gave the higher yield on M. robusta 5 rootstock. The yield of McIntosh-Hibernal-Anis was sig-nificantly greater than that of any other combination except Cortland-Hibernal-M. robusta 5. Seedling McIntosh was the least satisfactory rootstock.
Yield was not correlated with circumference of interstock. Variability in the latter was not reduced by the use of clonal rather than seedling rootstocks. No combination resulted in trees smaller than standard size.

McGill U., Macdonald Col., St. Anne de Bellevue, Quebec, Canada.

245. Mitterling, L. A. BIRD DAMAGE ON APPLES. Proc. Amer. Soc. Hort. Sci. 87: 66-72. 1965.

A 3-year study of bird damage on apples in a 9-acre orchard containing the varieties Cortland, McIntosh, Richared Delicious, and others indicated that the birds preferred them as food in the order listed. Greater damage occurred to fruit on trees located at the periphery of the orchard than to fruit on trees centrally located. The blue jay (Cyano-citta cristata) was the principal depredating species and preferred the variety Cortland.

Crows (<u>Corvus</u> <u>brachyrhynchos</u>), orioles (<u>Icterus</u> <u>galbula</u>), robins (<u>Tardus</u> <u>migratorius</u>), and starlings (<u>Sturnus</u> <u>vulgaris</u> <u>vulgaris</u>) also fed on apples. Typical damage on different varieties of apples by different bird species was described.

U. Conn., Storrs, Conn. 06268

246. Leefe, J. S. THE USE OF SIMAZINE AND ITS EFFECT ON THE YIELD AND LABOR TIME REQUIRED TO WEED STRAWBERRIES. Canad. J. Plant Sci. 45(6): 537-540. Nov. 1965.

In a 2-year trial, simazine at 2 lb./acre following plant establishment reduced the labor time required to weed strawberries without reducing yield. A second application of 2 lb./acre did not affect crop yield but did not further reduce labor time. Three applications of 2 lb./acre caused a severe yield reduction in 1 year of the test.

Res. Sta., Dept. Agr., Kentville, Nova Scotia, Canada.

247. Swanson, J. P., Garrett, J. R., and Zuroske, C. H. GROWERS' ESTIMATES OF PRODUCTION COSTS, CHERRIES, PEACHES, PEARS AND PRUNES, YAKIMA VALLEY, 1962 AND 1963. Wash. Agr. Expt. Sta., Sta. C. 452, 28 pp. 1965.

The data on production costs of cherries, peaches, and prunes were given for the crop year 1962. The data on pear production costs were for the crop year 1963.

Production costs for typical growers were: Sweet cherries (1962), $219 per ton; peaches (1962), $71 per ton; pears (1963), $62 per ton; and prunes (1962), $89 per ton.

Despite generally rising costs, production costs per ton for the fruits studied were only a little higher and sometimes lower than were found by studies for previous years. Such lower costs per ton but higher costs per acre resulted from actual and reported high yields in the study years.

The cherry costs were for sweet cherries and did not include pie or sour cherries. The peaches were freestone. The pears were canning pears, primarily Bartlett. The prunes and plums were primarily Italian prunes or purple plums.

Tables.

Wash. Agr. Expt. Sta., Col. Agr., Wash. State U., Pullman, Wash. 99163

## Field Crops

See Also 48, 51, 54, 65, 100, 113, 116, 119, 120, 125, 152, 159, 160, 168, 171-173, 175, 176, 178-180, 182, 185, 188, 197, 198, 203, 204, 207, 273, 276, 283, 322, 330.

248. Evatt, N. A. RICE REVOLUTION: GULF COAST STYLE. Tex. Agr. Prog. 11(2): 16. 1965.

Researchers at the Rice Pasture Research and Extension Center, Beaumont, Tex., were asked in 1960 to predict what Texas rice yields would be in 1975 and 2010.

Predictions for 1975 ranged from 4,000 pounds per acre on bottomland soils to 4,000 to 4,500 pounds on the remaining rice soils. The 1975 yield projections were based on the assumption of general acceptance of the present knowledge of seeding, fertilizing, and weed control with some double cropping.

These goals were met 4 years later--11 years ahead of schedule.

Texas rice farmers have experienced phenomenal increases in rice yields in the past 3 years. They have increased yields from the average of about 3,100 pounds per acre in 1957-62 to nearly 4,500 pounds in 1964.

Unforeseen rapid acceptance by Texas rice producers of results from two major applied research programs was responsible for meeting the 1975 predictions a decade ahead of time.

The boost came with the release of the Belle Patna variety of rice in 1961 and the release and wide-spread usage of a grass killer called propanil.

In the 1960 predictions for rice yields in 2010, it was estimated that yields would average from 8 to 10 thousand pounds per acre. This was based on the expectation of more efficient use of water, nearly perfect weed control, more knowledge of soil micro-biology and plant nutrition, varieties of 90-day maturity, and double cropping as a general practice.

Rice yields of more than 6,000 pounds per acre from one crop were obtained on experimental plots at the Beaumont Center. With continued interdisciplinary team-type research, average yields throughout the Texas rice belt will undoubtedly increase.

Texas A&M U., Tex. Agr. Expt. Sta., College Station, Tex. 77843


249. Andersen, A. L. DRY BEAN PRODUCTION IN THE LAKE AND NORTHEASTERN STATES. U.S. Dept. Agr., Agr. Res. Serv. Agr. Hbk. 285, 32 pp. 1965.


A "culture and care" publication was given on the production of dry beans in the Lake and Northeastern States.

Photographs and tables.

ARS, USDA, Inform. Div., FCB, Hyattsville, Md. 20782


250. Scott, W. A. A FORCED-WARM-AIR CURING SYSTEM FOR BURLEY TOBACCO. Canad. J. Plant Sci. 45(4): 315-319. July 1965.


The building and testing of a forced-warm-air system to prevent high humidity in Burley tobacco barns were described. The system utilized a small modified commercial crop dryer and an air-duct system constructed of light plywood and inflatable perforated polythene tubing. It effectively maintained the required humidity in wet weather.

Res. Sta., Canada Dept. Agr., Harrow, Ontario, Canada.

251. Shaw, L., Gossett, D. M., and Tugman, D. F. DATES OF TRANSPLANTING AND THE PROBABILITIES OF SPRING AND FALL FREEZES IN RELATION TO THE PRODUCTION OF BURLEY TOBACCO IN WESTERN NORTH CAROLINA. N.C. Agr. Expt. Sta. B. 426, 14 pp. 1965.


A 5-year study on dates of transplanting of burley tobacco in northwestern North Carolina showed that better yields of good quality of cured leaf were obtained when the crop was transplanted on May 20 and May 30 than were obtained when transplanted on June 10. The days from transplanting to maturity ranged from 97 to 106 days.

Freeze probabilities for the spring and fall months were calculated from temperature records collected at Banner Elk, Waynesville, and Andrews, N.C., during 1921-63. If a

10 percent probability of a freeze in the spring and in the fall were allowed, the number of freeze-free days that could be expected in western North Carolina, where burley tobacco is grown would range from 111 days in the northern counties to 136 days in the southern counties.

Burley tobacco growers in western North Carolina should adjust production practices to take advantage of the longest possible freeze-free growing period. The evidence indicated that these adjustments in production practices would result in measurable increases in yield and quality of the cured leaf and acre returns.

Agr. Expt. Sta., N.C. State, Raleigh, N.C. 27607

252. Tingey, D. C. CONTROL OF WILD OATS IN SMALL GRAINS. Utah Agr. Expt. Sta. B. 450, 16 pp. 1965.

The effects of date and rate of planting fall and spring-sown grains as well as the effects of row spacings, irrigation, fertilization, and the interrelation of these practices on the amount of wild oats and cereal crop yields were presented.

Factors affecting the amount of wild oats were: Rate of planting wild oats; date and rate of planting small grains; and row spacing. Irrigation and fertilization had little or no effect on the amount of wild oats. Factors affecting grain yields were: Date of planting; fertilization; rate of planting; and row spacing. While irrigation was necessary for high yields, different irrigation treatments had little or no effect on grain yields.

Date of planting small grains had more effect on the amount of wild oats than did the rate of planting wild oats. Wild oats were more prevalent in late planted fall grains and early planted spring grains. Even though there were fewer wild oats in late planted spring grains, the medium date of planting generally gave the highest crop yields.

Fall wheat in 1954 and 1955 tended to give higher yields with medium dates of planting. In 1958 and 1959, both fall wheat and fall barley gave progressively higher yields with earlier plantings.

Small grains planted at 1 bushel to the acre contained 32 percent more wild oats and yielded 8 percent less grain than that planted at 2 bushels to the acre. There was a date × rate of planting small grains interaction for amount of wild oats.

Spring wheat and spring barley in 1954 and spring barley in 1955 showed a date × rate of planting small grains interaction for yield, and the trend was similar for other grains. There was no difference in yield between the 1- or 2-bushel rate with early planting, but there was a difference in favor of the 2-bushel rate with late planting.

Agr. Expt. Sta., Utah State U., Logan, Utah. 84321

253. Buckholtz, K. P. FACTORS INFLUENCING OAT INJURY FROM TRIAZINE RESIDUES IN SOIL. Weeds 13(4): 362-367. Oct. 1965.

Factors influencing injury to oats from atrazine and simazine residues in the soil were studied over a period of 5 years. Initial rate of triazine application was highly important with significant injury in about one-half of the trials on plots treated with 2 lb./acre the year prior to planting oats and on all plots treated at 4 lb./acre. No material difference was found on plots treated with equivalent rates of atrazine and simazine. Granular preparations of atrazine left a residue that was more injurious than wettable powders.

Disking the seedbed for oats, rather than plowing, resulted in greater injury. Cultivation of the corn between the rows after treatment did not influence the injury the following year. Soil type did not have marked effect on injury. Above-normal average mean air

temperatures appeared to reduce injury the following year in some instances. Plants in experiments initiated in years of abundant rainfall during April to October tended to have less injury the next year than plants in experiments initiated in years when rainfall was limited.

U. Wis., Madison, Wis. 53706

254. Peters, E. J., Gebhardt, M. R., and Stritzke, J. F. INTERRELATIONS OF ROW SPACINGS, CULTIVATIONS AND HERBICIDES FOR WEED CONTROL IN SOYBEANS. Weeds 13(4): 285-291. Oct. 1965.

Combinations of row spacings, tillage, and herbicides were evaluated on Clark soybeans grown on Mexico silt loam. Weeds were not always completely controlled with amiben or PCP. When herbicides were used, soybeans in 20- and 24-inch rows usually needed no more than one cultivation, while those in 32- and 40-inch rows usually needed at least one and sometimes two cultivations for good weed control and high soybean yields. Soybeans in narrow rows always equalled and sometimes produced higher yields than those in wide rows. The soybean canopy covered the ground more rapidly in narrow rows than in wide rows so that when herbicides suppressed early weed growth, less weeds were produced in narrow rows than in wide rows. In some situations, cultivations increased soybean yields when few or no weeds were present.

No address given.

255. Staniforth, D. W. COMPETITIVE EFFECTS OF THREE FOXTAIL SPECIES ON SOYBEANS. Weeds 13(3): 191-193. July 1965.

Differences in the competitive effects of three major species of foxtail on soybeans were due primarily to differences in the mature plant yields of the species. Giant foxtail (Setaria Faberi) grew more vigorously and caused greater soybean yield reductions than did either yellow foxtail (Setaria lutescens) or green foxtail (Setaria viridis). The competitive effects of velvetleaf (Abutilon theophrasti) per hundredweight of mature weeds were approximately double those of yellow and green foxtail, but produced about the same yield reduction.

Iowa Agr. and Home Econ. Expt. Sta., Iowa State U. Sci. and Tech., Ames, Iowa. 50010

256. Knake, E. L., and Slife, F. W. GIANT FOXTAIL SEEDED AT VARIOUS TIMES IN CORN AND SOYBEANS. Weeds 13(4): 331-334. Oct. 1965.

Giant foxtail (Setaria faberii Herrm.) was seeded the day the crop was planted and 3, 6, 9, and 12 weeks later. Foxtail that began growing with the crop and was left to maturity reduced corn yields 13 percent and soybeans yields 27 percent. Foxtail seeded 3 weeks or later after the crop was planted did not cause yield reductions in corn or soybeans. Although not competitive, foxtail seeded 3 weeks after corn was planted produced 500 pounds of dry matter per acre, and all seedings in corn produced seed. Soybeans produced more shade than corn, and foxtail from the 3-week or later seedings in soybeans produced little or no dry matter or seed.

U. Ill., Urbana, Ill. 61803

257. Peacock, J. F., Burnside, O. C., Lavy, T. L., Hanway, D. G., and Kittock, D. L. FLAMING, INTERTILLAGE, AND CHEMICAL WEED CONTROL IN CASTOR-BEANS. Weeds 13(4): 290-291. Oct. 1965.

Maximum castorbean (Ricinus communis L.) yields were obtained from combinations of chemical and mechanical treatments. The rotary hoe controlled weeds when used for preemergence and during the early stages of crop growth. The flame cultivator gave pre-emergence weed control and was selective on weeds less than 4 to 5 inches tall after castorbeans had attained a height of 12 to 14 inches. The cultivator controlled weeds between castorbean rows, but weeds were occasionally found within the row. CDEC gave unsatisfactory preemergence weed control. EPTC gave excellent weed control at the 2 and 3 lb./acre rates; only the 3 lb./acre rate injured the castorbeans. NPA at 4 lb./acre gave good early weed control.

Agr. Ext. Agent, Logansport, Ind. 46947

258. Smith, R. J., Jr. PROPANIL AND MIXTURES WITH PROPANIL FOR WEED CON-TROL IN RICE. Weeds 13(3): 236-238. July 1965.

The herbicide propanil effectively controlled: Barnyardgrass (Echinochloa crusgalli (L.) Beauv.); brachiaria (Brachiaria platyphylla (Griseb.) Nash); crabgrass (Digitaria spp.); sesbania (Sesbania exaltata (Raf.) Cory); curly indigo (Aeschynomene virginica (L.) B.S.P.); spikerush (Eleocharis spp.); and umbrellasedge (Cyperus spp.) in the 1- to 4-leaf stages without significant injury to commercial varieties of rice in the 1- to 2-leaf stages. It was ineffective for control of: Ducksalad (Heteranthera spp.); redstem (Ammannia cocinea Rottb.); morning glory (Ipomoea spp.); sprangletop (Leptochloa pani-coides (Presl.) Hitchc.); and red rice (Oryza sativa L.). Mixtures of propanil and a blended surfactant containing petroleum sulfonate, free and combined fatty acids, and petroleum oil, and mixtures of propanil, CIPC, and swep controlled barnyardgrass better than propanil alone. Propanil sometimes injured the rice, but the plants recovered in 5 to 10 days after treatment and yield and quality were unaffected.

CRD, ARS, USDA, Stuttgart, Ark. 72160

259. Adkisson, P. L., and Nemec, S. EFFICIENCY OF CERTAIN INSECTICIDES FOR KILLING BOLLWORMS AND TOBACCO BUDWORMS. Tex. Agr. Expt. Sta. Prog. Rpt. PR-2357, 11 pp. 1965.

Insecticides and insecticidal mixtures were tested in the laboratory for effectiveness in killing third and fourth instar larvae of the bollworm (Heliothis zea (Bod.)) and the tobacco budworm (H. virescens (F)).

The bollworm was highly resistant to DDT, but was effectively controlled with endrin, Sevin, strobane-DDT, toxaphene-DDT, and a number of mixtures in which these insec-ticides were included.

The tobacco budworm was highly resistant to DDT, and there was evidence of resist-ance to endrin, Sevin, strobane-DDT, and toxaphene-DDT. Good kills of this species were obtained only with mixtures of two or more insecticides. Two new insecticides, Azodrin and Matacil, showed promise against both species.

Differences in the comparative susceptibility of the two species to the insecticides were great. Greater quantities of insecticides were required to kill tobacco budworms than an equal percentage of bollworms. The difference in susceptibility between the two species varied from 1- or 2-fold to more than 1,000-fold, depending upon the insecticides.

Tex. A&M U., Tex. Agr. Expt. Sta., College Station, Tex. 77843

# Vegetable Crops

260. Somerfeldt, T. G., and Knutson, K. W. EFFECTS OF NITROGEN AND PHOSPHORUS ON THE GROWTH AND DEVELOPMENT OF RUSSET BURBANK POTATOES GROWN IN SOUTHEASTERN IDAHO. Amer. Potato J. 42(12): 351-360. Dec. 1965.

Field and greenhouse trials, supplemented with laboratory analyses, were used to study the effects of nitrogen and phosphorus on the growth and development of Russet Burbank potatoes in southeastern Idaho.

It appeared that both nitrogen and phosphorus had direct effects on the growth and development of the potatoes. Both affected the concentration of different elements in the plant tissue and tuber size. Reduction in tuber size as a result of nitrogen alone was evident in the greenhouse but not in the field. Reduced tuber size as a result of phosphorus was evident in both the field and greenhouse studies. In the greenhouse, excess nitrogen reduced the tuber set; excess phosphorus delayed plant emergence; and growth rate, primarily top growth, was increased by both nitrogen and phosphorus.

Agr. Expt. Sta., U. Idaho, Aberdeen, Idaho. 83210

261. Sparks, W. C. EFFECT OF STORAGE TEMPERATURE ON STORAGE LOSSES OF RUSSET BURBANK POTATOES. Amer. Potato J. 42(9): 241-246. Sept. 1965.

Three storage trials involving Idaho-grown Russet Burbank potatoes showed that storage at $45^O$ resulted in less weight loss than storage at $38^O$ or $52^O$ F. Unwashed potatoes stored at $45^O$ had less storage loss throughout a 345-day storage period than tubers from the same source stored at $38^O$ or $52^O$ F. Washed tubers destined for the fresh market and treated with various inhibitors in April had less loss after 90 days of storage at $45^O$ than at $38^O$, $52^O$, or $59^O$ F. After 130 days of storage, $38^O$ F showed the least loss. Washed and unwashed potatoes stored at $45^O$ in CIPC treated bags for 92 days showed less loss than those stored at $38^O$, $52^O$, $59^O$, or $68^O$ F.

Idaho Agr. Expt. Sta., U. Idaho, Moscow, Idaho. 83843

262. Kushman, L. J., and Wright, F. S. OVERHEAD VENTILATION OF SWEET POTATO STORAGE ROOMS. N.C. Agr. Expt. Sta. Tech. B. 166, 29 pp. 1965.

Sweet potatoes were stored during October in a small experimental storage house at Clayton, N.C., and in a commercial storage house at Wilson, N.C. The sweet potatoes were cooled satisfactorily after curing by ventilating with blowers controlled by differential thermostats or time clocks to introduce cool (night) air into the top of storage rooms until a cooling thermostat set at $55^O$ F. was satisfied. Introducing the cool air into the top of the rooms usually decreased the temperature difference from top to bottom in the rooms and at times produced temperature inversion; whereas introducing the cool air into the bottom of the storage rooms often increased the difference in temperatures at the top and bottom of storage rooms. The satisfactory temperature range of $55^O$ to $50^O$ F. was seldom exceeded during the periods that the overhead ventilation system was in use, i.e., approximately October 15 to December 1 and March 1 to May 15 each of 2 years.

Relative humidity was maintained at 75 percent or above except when a large amount of cold or dry air was introduced during the day.

Roots stored in the rooms cooled with overhead ventilation have kept well until May 15. Until refinements can be developed, it was suggested that air be introduced into the top of storage rooms at a rate of 1 to 2 c.f.m. per bushel of sweet potato storage capacity and exhausted through louvered vents at the top of the outside walls so as to create a layer of cool air across the top of the room over the stored roots.

N.C. Agr. Expt. Sta., N.C. State, Raleigh, N.C. 27607

263. Sawyer, R. L., Boyd, L. L., Cetas, R. C., and Bennett, A. H. POTATO STORAGE RESEARCH ON LONG ISLAND WITH FORCED-AIR VENTILATION SYSTEMS. N.Y. State Agr. Expt. Sta. (Cornell) B. 1002, 31 pp. 1965.

Potato storage research was conducted during the years 1953-60 in especially prepared laboratory facilities. Various storage techniques were evaluated on a commercial scale to find better ways of providing an optimum storage environment in automatically controlled, forced-air-ventilated storages on Long Island.

Studies were conducted in six 400-bushel-capacity storage rooms. The treatments included were: Varying airflow rates; application of moisture by various methods and at different rates; use of sprout inhibitors at storage temperatures of 40$^{\circ}$ and 50$^{\circ}$ F.; effect of cultural factors such as planting, harvest dates, and methods of harvest of the stored potato; and comparison of the Kennebec with the Katahdin variety.

Quality evaluations were made by measuring percent of shrinkage, black spot, specific gravity, bruising, air checking, hardness, peeling discoloration, grade, and incidence of fusarium dry rot.

Some treatments were repeated for several years, while others were discarded after a year or two because of obviously undesirable effects. Years were used to provide some measure of replication. Treatments within a year were varied among five ventilated rooms. A refrigerated room in which temperature and humidity could be closely controlled was used as a check. Data were analyzed statistically.

The most desirable storage environment was provided by: Carefully regulating the airflow (0.83 cubic feet per minute per hundredweight; adding adequate moisture to the ventilating air; using a strong sprout inhibitor; delaying harvest; and storing at 50$^{\circ}$ F.

Cornell U., Agr. Expt. Sta., N.Y. State Col. Agr., Ithaca, N.Y. 14850

264. Francis, F. J., and Thomson, C. L. OPTIMUM STORAGE CONDITIONS FOR BUTTERNUT SQUASH. Proc. Amer. Soc. Hort. Sci. 86: 451-456. 1965.

Samples of Butternut squash were stored in small cabinets with good air circulation maintained at temperatures from 45$^{\circ}$ to 75$^{\circ}$ F. and 40 to 70 percent relative humidity (R.H.) in cold rooms and in common storage. Decay, weight loss, and development of hollow-neck were followed for four seasons in cabinets and two seasons in cold rooms. Medium temperatures and low humidities markedly decreased decay but increased weight loss and hollow-neck development. High temperatures produced skin discoloration and weight loss. Weight loss should be kept below 15 percent to minimize hollow-neck development. A reasonable compromise between decay, weight loss, and hollow-neck development was storage at 50$^{\circ}$ F. and 50 percent R.H.

Four anti-microbial chemicals, 0.5 percent sodium dehydroacetate, 0.5 percent potassium sorbate, and 0.2 percent Dithane used as a prestorage dip were ineffective in reducing decay. A 2-minute dip in water at 130$^{\circ}$ or 140$^{\circ}$ F. reduced decay.

U. Mass., Amherst, Mass. 01003

265. Cannon, F. M., and Callbeck, L. C. HIGH VERSUS LOW VOLUME SPRAYING OF
POTATOES. Amer. Potato J. 42(11): 328-332. Nov. 1965.

Under the severe disease conditions that prevailed in Prince Edward Island, Canada,
in 1962-63, fungicide applied in 120 gallons of water per acre gave better control of late
blight on the foliage, higher yields of tubers, and better control of tuber rot than the
same fungicide, applied at the same dosage, but carried in 40 gallons of water per acre.
In both types of equipment used, (low volume or high volume) better disease control was
gained when the boom carried drop nozzles.
There was very little difference between the effect of high and low volume spraying,
or between the two patterns of nozzle placement, on the control of flea beetles. With these
insects, the close similarity among the control results was probably caused by their
moving frequently from one plant to another.
For aphids, which are relatively inactive, the high volume spray gave more superior
control than the low volume one. The nozzle arrangements on the high volume machine
did not cause much difference in the control of aphids, as the arrangement that had drop
nozzles was only slightly superior. With the low volume equipment, the use of drop noz-
zles resulted in superior control of aphids.

Expt. Farm, Canada Agr. Expt. Sta., Charlottetown, Prince Edward Island, Canada.

266. Manzer, F. E., Cetas, R. C., Partyka, R. E., Leach, S. S., and Merriam, D.
INFLUENCE OF LATE BLIGHT AND FOLIAR FUNGICIDES ON YIELD AND
SPECIFIC GRAVITY OF POTATOES. Amer. Potato J. 42(9): 247-252. Sept. 1965.

In fungicide trials conducted over several years in Maine and Long Island, N.Y.,
yield and specific gravity measurements on Katahdin and Green Mountain potatoes were
strongly influenced by the extent of defoliation by the late blight disease. High correlation
coefficients for these two factors with defoliation were obtained. In some of these tests,
the disease was not present as a result of unfavorable weather. Under these conditions,
no statistically significant difference s in either yield or specific gravity were found
among fungicide-treated or untreated potatoes. Certain experimental fungicides, however,
caused visible phototoxic effects which were reflected in lower yields and lower specific
gravity.

Maine Agr. Expt. Sta., Orono, Maine. 04473

267. Harrison, M. D., Livingston, C. H., and Oshima, N. CONTROL OF POTATO EARLY
BLIGHT IN COLORADO. I. FUNGICIDAL SPRAY SCHEDULES IN RELATION TO THE
EPIDEMIOLOGY OF THE DISEASE. Amer. Potato J. 42(11): 319-327. Nov. 1965.

Two to three spray applications timed properly controlled early blight infection in
potatoes equally as well as the five to seven spray applications commonly used. Early
sprays were of little importance in the overall blight control program. Effective spray
schedules were those which began at or near the time of secondary spread, as measured
by spore trapping techniques. This timing proved superior to schedules begun earlier or
later than this date in that equal or better blight control was attained at reduced cost.
The possible role of spore traps as guides for timing initial applications of fungicides on
a commercial scale was suggested.

Colo. Agr. Expt. Sta., Fort Collins, Colo. 80521

268. Harrison, M. D., Livingston, C. H., and Oshima, N. CONTROL OF POTATO
EARLY BLIGHT IN COLORADO. II. SPORE TRAPS AS A GUIDE FOR INITIATING
APPLICATIONS OF FUNGICIDES. Amer. Potato J. 42(11): 333-339. Nov. 1965.

The use of weather-vane spore traps with vaseline coated slides was an effective
means of timing initial fungicide applications for potato early blight control in Colorado.
This technique was simple and more reliable than some methods currently being used.
Effective control of early blight was achieved with fewer sprays by using this system
rather than plant growth stage as the basis for initiating fungicide applications. The
method promises to be most useful in areas where crops with diseases caused by fungi
that produce spores similar to those of A. solani are not grown in close association with
potatoes.

Colo. Agr. Expt. Sta., Fort Collins, Colo. 80521

269. Pullen, W. E., and Tuthill, D. F. COST OF PRODUCING POTATOES: CENTRAL
AROOSTOOK COUNTY, MAINE. Maine Agr. Expt. Sta. B. 635, 49 pp. 1965.

A study was undertaken in 1959-60 to describe the present potato situation in Maine
and to identify ways available to the grower for reducing costs and improving his eco-
nomic position. Information was collected by means of field surveys on 180 farms in
Aroostook County over a 2-year period on small-size (20 to 49 acres), medium-size
(50 to 149 acres), and large-size (150 to 330 acres) potato farms.
    Potatoes were grown on all farms studied. Oats were grown in the potato rotation on
most farms, while peas for processing were found on 11 percent of the farms. Typical
rotations were either three years (potatoes, oats, and hay,) or four years (two years of
potatoes and one each of oats and hay).
    The labor force on the small-size farm was 1.3 man equivalent, medium-size 2.3,
and large-size 7.2. Investment per acre of potatoes was $674, $626, and $683, respectively.
    The 180 growers stored 90 percent of their entire production.
    The costs for planting, growing, harvesting, and storing potatoes amounted to an
average of $383 per acre. The average yield, field run, was 173.5 barrels, resulting in
a cost of $2.20 per barrel. The costs included: All operating costs; depreciation and
interest on land and capital investment; and a labor and management return to the
operator. Costs for the small, medium, and large size farms were $387, $396, and $361
per acre, respectively, and $2.33, $2.22, and $2.11 per barrel.
    Labor was the largest single annual cost item, comprising 35 percent for all farms.
Land and building costs accounted for 15 percent of all costs; fertilizer, 14 percent; and
seed, 12 percent. The cost of owning and operating trucks and tractors was 10 percent of
all costs, and equipment added another 5 percent. Spray material amounted to 4 percent
of all costs, and miscellaneous costs amounted to 5 percent.

Maine Agr. Expt. Sta., Orono, Maine. 04473

## ECONOMIC AND SOCIAL ASPECTS OF
## SOIL AND WATER CONSERVATION

### Costs and Returns

270. Moysey, E. B., and Wilde, D. H. DRYING GRAIN WITH UNHEATED AIR. Canad. Agr. Engin. 7(1): 12-13. Jan. 1965.

An investment of a few hundred dollars in equipment for drying grain with unheated air might be worthwhile for farmers in a large part of Saskatchewan. In many cases, it would permit earlier harvesting of a few thousand bushels, even though the grain was in a tough condition. This could well mean savings in field losses and/or grade of grain that would repay the cost of equipment in a single year. In years of extremely poor harvest weather, some drying could be accomplished in the fall and the grain could be stored safely over winter by blowing cold air through it occasionally. Drying could then be completed in the spring.

U. Saskatchewan, Saskatoon, Saskatchewan, Canada.

271. Jones, L. A., and Larson, D. K. ECONOMIC IMPACT OF FEDERAL CROP INSUR-ANCE IN SELECTED AREAS OF MONTANA AND VIRGINIA. U.S. Dept. Agr., Econ. Res. Serv. Agr. Econ. Rpt. 75, 36 pp. 1965.

Insurance with the Federal Crop Insurance Corporation provides a means by which some farmers can reduce the financial impact of crop failures. The effect was studied of Federal Crop Insurance (FCI) on farmers, on businesses that deal with farmers, on local economics, and its impact on other Federal programs, particularly emergency loans of the Farmers Home Administration (FHA). The authors concluded that:

1. FCI provided an important means by which farmers have reduced the financial impact of crop losses, particularly those farmers with less farm diversification, smaller incomes, fewer savings, and larger debts.
2. FCI indemnities alleviated the effects of drought losses for insured growers.
3. Despite its better basic situation, the uninsured group included some growers with relatively risky situations and weak financial positions.
4. Lenders reported that, in comparable situations, insured growers repaid loans better than did uninsured growers.
5. Lenders seldom required borrowers to carry FCI. The 1963 drought, however, made lenders more aware of its value.
6. Some lenders have not been fully informed about FCI.
7. Local supervisors of the FHA reported better repayment from insured than from un-insured borrowers.
8. If more growers had carried FCI, the need for FHA emergency loan financing probably would have been less following the drought in 1963.
9. Farm suppliers usually did not know which of their customers had FCI and said that it made little difference to them in extending credit. Most believed insured farmers were easier to collect from.
10. Bankers, other lenders, businessmen, and tax collectors believed that FCI in-demnities bolstered local economies, especially in the more rural communities.

OMS, USDA, Inform. Div., Washington, D.C. 20250

272. Dawson, G. R. COSTS OF OWNING AND OPERATING FARM MACHINERY. N. Mex. Agr. Expt. Sta. B. 493, 17 pp. 1965.

Information was presented about the costs of operating tractors and other selected machines on farms in New Mexico.

In six southern New Mexico counties, 49 farmers were interviewed to obtain data on their 1960 farming operations. Machinery and fuel prices were obtained for 1961 from dealers in the area.

Farmers with less than 100 acres of cropland had an investment in tractors and seedbed preparation equipment of $50.41 per acre, but farmers with 400 acres or more of cropland had an investment of only $14.50 per acre. Cost per hour of tractor use declined with use, regardless of the tractor size. Fuel was the largest item in operating cost, and gasoline was the most commonly used fuel, especially in the smaller tractors. Liquified petroleum gas and diesel fuels were common for the newer and larger tractors.

Cost per hour and per acre of use of some important farm implements were reported. These costs were estimated for average conditions and were not exact costs for any specific machine or farm. With the methods used for computing these average costs, a farmer can compute his own costs for any specific piece of equipment.

Custom rates for major operations were also reported. These rates were obtained through a mail questionnaire sent to farmers who performed custom work in 1960.

Tables.

Agr. Expt. Sta. N. Mex. State U., State College, N. Mex. 88070

273. Warren, G. R., and Mullins, T. ADJUSTMENTS ON RICE FARMS TO CHANGING CONDITIONS, NORTHEAST ARKANSAS RICE AREA. Ark. Agr. Expt. Sta. Rpt. Ser. 137, 22 pp. 1965.

Information was given that is useful in appraising the effects of changes in technology, price relationships, and acreage controls on the organization and income of rice farms located on loessial terrace soils in the northeast Arkansas rice area. A representative 531-acre farm was selected to depict the major adjustment opportunities. Linear programming procedures were used to determine the optimum combination of enterprises.

In adjusting from the present technology level to the advanced technology level at equilibrium prices, the land use pattern shifted from a diversified cropping system of rice, soybeans, wheat, and cotton to a more intensive cropping system of rice and cotton. This shift plus increases in per acre yields with advanced technology resulted in a considerable increase in total production of rice and cotton. Returns to management increased from $4,211 with present technology to $21,979 with advanced technology.

Varying the price of rice, soybeans, or cotton influenced the farm organization and income. As the rice price increased and all other crops remained at the equilibrium price level, the farm organization changed from cotton-corn to rice-cotton-corn and then to rice-cotton. With cotton at current prices and soybeans at equilibrium price, the cropping system shifted from all cotton to rice and cotton as rice price increased. With soybeans at current prices and cotton at equilibrium price, increasing the rice price varied the farm plan from soybeans-wheat-cotton to rice-soybeans-wheat-cotton and then to rice-soybeans-cotton. The returns to management ranged from $16,310 to $47,551. With acreage allotments on rice and cotton, the remaining land was planted in soybeans and wheat. The returns to management on the representative farm with the assumed conditions were greater with allotments and current prices than with no controls and equilibrium prices. Returns with allotments totaled $30,318 while returns with no allotments totaled only $21,979.

Tables.

Agr. Expt. Sta., U. Ark., Fayetteville, Ark. 72701

274. Cooper, S. T., and Colyer, D. EFFECTS OF LAND ACQUISITION ALTERNATES ON OPTIMAL FARM PLANS FOR NORTH MISSOURI. Mo. Agr. Expt. Sta. Res. B. 877, 43 pp. 1965.

The optimum combination was determined of enterprises for the given resource levels on three types of farms in three areas of northern Missouri. The study was conducted in the Northeast Area for hog farms, in the North-Central Area for mixed livestock farms, and in the Northwest Area for cash grain farms. Three different sizes of each type of farm were included in the analysis. Resource levels were developed for each representative farm on the basis of sample survey made in 1962. Solutions using linear programming were computed at various price levels for corn, hogs, and beef cattle to obtain optimal farm organizations where land acquisition was permitted.

The optimal solutions contained many implications for farm adjustments in northern Missouri. The potential for adjustment was very great. This indicated that the rapid changes of recent years will continue. Other major conclusions were:

1. Under the assumed conditions, farms of the type studies in northern Missouri could increase their income considerably.
2. Farms were not fully utilizing all resources.
3. With the coefficients and prices used, farms were not as large as they should be to maximize profits.
4. It was more profitable to have an efficient livestock enterprise through which grain was marketed than to sell the grain outright.
5. It was profitable to purchase corn or other feed grains to expand livestock production. Where land was available, limited capital was more profitably employed in purchasing land and in growing grain to expand livestock output.
6. Livestock production per farm tended to be about as large with expanded acreages as with land fixed.

U. Mo., Agr. Expt. Sta., Columbia, Mo. 65202

275. Connor, L. J., and Walker, O. L. POTENTIAL LONG-RUN ADJUSTMENTS FOR OKLAHOMA PANHANDLE FARMS. Okla. Agr. Expt. Sta. Tech. B. T-114, 60 pp. 1965.

A rough check on the appropriateness of each potential adjustment considered was provided by current and historical adjustments and trends in farm size.

Of the various adjustments considered, the hypothesis that farmers acquire some minimum amounts of resources sufficient to obtain an acceptable return to labor and management did not appear to be an adequate explanation of this trend in farm sizes. Different adjustments recognizing effects of owned resources, alternative yield expectations, and the interaction of these items all appeared to provide more plausible explanations.

The interaction of the "owned resources" and "yield expectations" hypotheses provides a possible explanation of financial or firm survival in the Panhandle Region.

A number of developments appear likely in the Panhandle. The number of farms and farmers apparently will continue to decline because of the continued demand for the land resource to obtain units of the required size, and the tendency for equalization of earnings to labor and management in different sectors of the economy.

The total acreages of the major crops considered apparently will not change significantly with reductions in the number of farms and farmers.

Drastic changes in the price levels for wheat and grain sorghum would greatly influence the total returns of farm operators and their long-run adjustments because of limited production alternatives in the Panhandle Region.

With adjustments in the number of farms and farmers, there will naturally be repercussions for agribusiness, consumer or service businesses, local government, schools, churches, and other groups.

Okla. State U. Expt. Sta., Stillwater, Okla. 70475

276. Grant, W. R., and Mullins, T. ADJUSTMENTS ON RICE FARMS TO CHANGING CONDITIONS, GRAND PRAIRIE, ARKANSAS. Ark. Agr. Expt. Sta., Rpt. Ser. 134, 31 pp. 1965.

Five representative farm situations in the Grand Prairie of Arkansas were developed to depict major adjustment opportunities to changing technology and to changing rice and soybean prices. Budgets were prepared for each size of farm, and linear programming procedures were used to select the optimum combination of enterprises. Two sets of programs were computed. The first set was with present technology and all prices at the free-market or equilibrium level. The second set was with advanced technology, variable rice prices, and soybean and oat prices at both equilibrium and current levels.

Rice was in all programs at the maximum level allowed by the irrigation water restriction with present and advanced technology and equilibrium prices. With present technology, soybeans were not profitable on the non-riceland. Thus, the land was idle. With advanced technology the non-riceland was fully used for producing soybeans and double-crop oats.

Rice production with advanced technology was 35 percent above rice production with present technology. Soybean production increased 48 percent with advanced technology.

Increasing the price of rice while holding the prices of soybeans and oats constant eventually placed rice in a more profitable position relative to soybeans and oats. The lowest rice price at which this favorable position occurred with soybeans and oats at equilibrium prices was $2.33 per hundredweight.

Income was affected by price variations. Returns to management ranged from -$1,897 with rice at $2.33 and soybeans and oats at equilibrium prices to $27,337 with all crops at current prices.

With equilibrium prices, aggregate production for rice produced with advanced technology would be about 40 percent greater than the aggregate production with present technology. Soybean production would increase almost 75 percent. An additional 12.6 million bushels of oats also would be produced.

Tables and graphs.

Agr. Expt. Sta., U. Ark., Fayetteville, Ark. 72701

277. Justus, F. E., Jr., and Alexander, R. D. COST MINIMIZING PLANS FOR VARIOUS TYPES OF FARMS IN NORTHEAST MISSOURI. Mo. Agr. Expt. Sta. Res. B. 879, 44 pp. 1965.

Typical resource situations in northeast Missouri were selected through the use of linear programming the cost minimizing plans for different types of farm businesses and varying levels of net income. The three typical land resource situations selected for analysis were: (1) Level Upland Farm--a farm comprised of all level upland; (2) Rolling Upland Farm--a farm comprised of 25 percent level upland, 50 percent tillable rolling upland, and 25 percent rolling pasture land; and (3) Bottomland Farm--a farm comprised of 50 percent bottomland, 25 percent tillable rolling upland, and 25 percent rolling pasture land.

Optimum plans (cost minimizing plans) were determined for four types of farm business: (1) Hog; (2) dairy; (3) beef--with emphasis on roughage-fed cattle; and (4) beef--with emphasis on grain-fed cattle. Cost minimizing plans were obtained for each of these types of business located on the three differing land resource situations and for varying net income levels. The basic framework called for determining cost minimizing plans for net income levels from $3,000 to $7,000, at $1,000 intervals.

Included in the publication were the amounts and combinations of resources used in each cost minimizing plan, the specific crop and livestock enterprises involved, and the total annual cost of obtaining each income level.

U. Mo., Agr. Expt. Sta., Columbia, Mo. 65202

278. Adkins, W. G. PROJECTIONS TO 1970 OF SELECTED CHARACTERISTICS OF FARMS IN THE BLACKLAND PRAIRIES: AN APPLICATION OF EMPIRICAL ESTIMATING PROCEDURES. Tex. Agr. Expt. Sta. Tech. Monog. 2, 66 pp. 1965.

Projections were presented to 1970 of farm numbers, farmland acreage, and cropland harvested for 16 Blackland Prairie counties. The estimates included distributions of farms by age and tenure of farm operators and by size of farm. Farmland and cropland acreages were distributed by farm tenure and farm size. The major expectations developed by the study were:

1.  The number of farms in the area will decrease by 43 percent.
2.  The 1970 farmland acreage in the 16 counties will remain at the 1959 level of about 7,702,000 acres. The 1970 cropland acreage was projected to be about 2,084,000 acres, or 27 percent less than in 1959.
3.  The average age of farm operators will continue to increase.
4.  All three major tenure groups will lose farm operators from 1959 to 1970.
5.  Full owners will decrease in number but will operate about 52 percent of the farms in 1970 versus 48 percent in 1959.
6.  Part owners will experience a drop in numbers, but the percentages of farms, farmland, and cropland controlled by this group will increase.
7.  Full-owner farms will average 284 acres in size in 1970 compared to 167 acres in 1959. Part owners will operate an average 652 acres of farmland in 1970 with 191 acres of cropland. The average farm size for tenants will increase from 228 acres in 1959 to 388 acres in 1970.
8.  Only farms of 260 acres and over in size will increase in number.
9.  The projected changes in Blackland farms and farm operators were expected to have important implications for farm income in the area.

Tex. Transport Inst., Tex. A&M U., College Station, Tex. 77843

279. Heady, E. O., and Butcher, W. R. EFFECT OF FEED-GRAIN OUTPUT CONTROLS ON RESOURCE USES AND VALUES IN NORTHERN AND SOUTHERN IOWA. Iowa Agr. Expt. Sta. Res. B. 531: 267-300. Jan. 1965.

The potential effects of direct control over the output of feed concentrates were studied.

Representative farms were selected for analysis from two Iowa areas--an eight-county area in the south-central Iowa Corn Belt fringe area and a seven-county area in the northern Iowa central Corn Belt cash-grain area.

Linear programming models of representative farms were formulated assuming: (1) Average technologies and rates of efficiency in production process; (2) a shortrun planning situation in which land, labor, and machinery investments were fixed; and (3) profit maximization as the goal to which production was directed. The effect of output control was estimated by comparing profit-maximizing production plans without output control with plans where output of feed concentrates were controlled.

Substitution of soybeans for corn was a typically profitable response on cash-grain farms and other farms that would ordinarily produce crops for sale in addition to producing their own livestock feed. Increased beef production was a profitable adjustment of output control for almost all livestock farms. The increase in beef was, in part, offset by decreased hog production. The greatest increase in beef production was indicated for farms that were not limited by capital supply. Increased beef output was associated with increased forage production on land diverted from concentrate-producing crops.

Decreased output through direct control of feed-concentrate output would lead to partially compensating increases in the output of alternative products.

A reduction in the total amount of resources used was profitable for most farms when there was control over feed-concentrate output. Variable costs of crop production, including expenditures for commercial fertilizer, decreased as output controls forced reductions in: (1) The acreage of intertilled crops; (2) the acreage of cropland harvested; and (3) the level of fertility that was profitable to maintain.

Agr. and Home Econ. Expt. Sta., Iowa State U. Sci. and Tech., Ames, Iowa 50010

280. Gerlow, A. R., and Campbell, J. R. ENTERPRISE COSTS AND RETURNS FOR BEEF CATTLE; SOUTHWESTERN LOUISIANA RICE AREA. La. Agr. Expt. Sta. Dept. Agr. Econ. Res. Rpt. 137, 55 pp. 1965.

To maximize net incomes, farm operators must constantly re-evaluate the economic and physical potential relating to their individual farm businesses. Attention should be given to the quantity of resources (labor, land, capital, and management) employed by the farm firm and to the combination of these resources in the production of various farm enterprises. The effect of various price changes on the combination of farm enterprises should also be considered.

An economic description of the resources presently being utilized by the beef cattle enterprise in the Louisiana rice area and the level of returns resulting from use of these resources were given. An analysis was made for beef cattle produced under improved levels of technology and production with emphasis on rotations and improved pasture programs. Returns were shown for various improved pasture programs, production levels, and price ranges.

La. State U. and Agr. and Mech. Col., University Station, Baton Rouge, La. 70803

281. Botkin, M. P., Kercher, C. J., and Paules, L. PREPARATION OF HAY AND GRAIN FOR LAMB-FATTENING RATIONS. Wyo. Agr. Expt. Sta. B. 429, 13 pp. 1965.

Four lamb-feeding trials were made including comparisons of pellet size, concentrate level, and preparation methods for barley or hay when fed in mixed rations.

No significant differences were found in lamb performance between those fed 1/4-inch pellets and those fed 3/4-inch pellets with the same ingredients.

High-concentrate pellets were unsatisfactory in one trial, presumably because of extremely hard texture which limited feed consumption. In the other trial, high-concentrate

pellets were utilized more efficiently than were hay-grain pellets. Lamb gains were essentially the same on both rations; however, cost of gains was higher for lambs fed high-concentrate pellets.

Lambs gained faster and more efficiently, but their feed cost/cwt. gain was higher when they were fed rations containing hay pellets than when they were fed rations containing ground hay. Whole, rolled, and ground barley, as part of mixed rations, were nearly equal in their influence on lamb performance. Feeding pelleted barley as part of rations resulted in slower, less efficient, and more expensive lamb gains than feeding barley prepared in other ways.

Agr. Expt. Sta., U. Wyo., Laramie, Wyo. 82071

282. Oliver, J. D., and Kline, R. G. OPTIMUM ENTERPRISE COMBINATIONS FOR BEEF COW AND CALF FARMS IN SOUTHWEST VIRGINIA. Va. Agr. Expt. Sta. B. 180, 86 pp. 1965.

Many beef cow and calf farmers in southwest Virginia have faced the problem of low efficiency of resource use as indicated by low net income. Typical beef cow and calf farms in three size groups (56, 150, and 295 acres open land) were selected for study to determine the combination of enterprises which would maximize returns to the fixed resources. The planning period for adjustment was short-run, with these resources considered fixed: Land; operator and family labor; machinery; equipment; buildings; and investment capital. A resource considered fixed could not be used off the farm or sold during the planning period. Provision was made to hire additional labor and borrow capital to invest in buildings and equipment.

The results indicated that typical beef cow and calf farmers could more efficiently use their resources and increase net income. Optimum plans for the typical farms included wintering steer and market-hog enterprises. Corn silage was one of the most profitable crops for the typical farms, and it was profitable (by purchasing additional feed) to expand livestock production beyond that possible with farm-produced feeds.

Results indicated possible net returns to operator's labor and management of about $4,900 for the 56-acre farm, $10,300 for the 150-acre farm, and $16,400 for the 295-acre farm. These incomes reflect the potential which may be realized with specified projected prices and a high level of management. If market price of wintered steers and market hogs should decrease 5 percent below the projected price, net returns to operator's labor and management in the optimum plans would decrease about 60 percent. Slightly more than an 8-percent drop in the price of hogs and steers would reduce net returns to operator's labor and management to zero.

A wintering steer enterprise was a relatively better alternative than raising hogs on the larger typical farms.

Va. Agr. Expt. Sta., Va. Polytech. Inst., Blacksburg, Va. 24061

283. Partenheimer, E. J., and Strickland, P. L., Jr. OPTIMUM FARM ORGANIZATION WITH DIFFERENT LIVESTOCK PRICES, LIMESTONE VALLEY AREAS OF ALABAMA. Auburn U. Agr. Expt. Sta. B. 357, 25 pp. 1965.

Adjustment opportunities were studied on an owner-operated Limestone Valley farm in Alabama with 160 acres of open land. Labor was hired only for activities that required more than one man. A 6-percent per annum charge was made on all operating and investment capital. Input and product prices were assumed to be at about the current levels with appropriate trend and cyclical adjustments.

Enterprise alternatives were land based. They included both conventionally planted and skip-row cotton (28.8-acre allotment), corn, oats, grain sorghum, soybeans, lespedeza hay, steers, and hogs. A high level of managerial ability and the use of improved production practices were assumed in all the enterprise budgets.

Optimum farm organizations were computed for various combinations of steer and hog prices using linear programming and price mapping procedures. The most profitable farm plans included cotton, corn, hog, steer, and oats enterprises.

The study indicated that Limestone Valley farmers would have higher returns if they planted all of the cotton allotment they could obtain, provided they used improved production practices and expected hog prices to average less than $17.50 per hundredweight. When hog prices were expected to average more than $17.50, it was more profitable to reduce cotton acreage and increase corn and hog production to the extent allowed by labor restrictions.

Skip-row cotton should be planted for hog prices to average below $14.40 per hundredweight. This would reduce the size of the corn and hog enterprises.

Steers entered the most profitable farm plans only when steer prices were relatively high as compared to hog prices.

Land that can be used only for close growing crops was used for oats when it was not needed for hay and pasture. Wheat or other small grains could be substituted for oats with little change in returns.

Tables, charts, and maps.

Agr. Expt. Sta., Auburn U., Auburn, Ala. 36830

284. Schutz, W. D. DAIRYING IN WYOMING. Wyo. Agr. Expt. Sta. B. 431, 20 pp. 1965.

In a study of dairying in Wyoming, the author concluded that:

1. The trends for 1953-62 inclusive were: (1) The number of Wyoming dairy cows declined from 42,000 to 28,000, and total milk production declined from 215 million pounds to 180 million pounds. (2) While milk sold to plants and dealers increased by 25 million pounds, or 25 percent, the amount of milk equivalent of farm-separated cream sold declined by 32 million pounds, or about 58 percent. Milk used on farms where produced declined by 22 million pounds, or 45 percent. And (3) total amount of Grade A milk marketed increased by 18 million pounds, or 33 percent. The number of Grade A herds increased in size from 21 to 43 head.

2. The costs and returns for producing Grade A milk of 3.5 percent butterfat was shown in the following table:

|  | 40-cow herd | 60-cow herd |
| --- | --- | --- |
| Cost (net of credits per cwt.) | $3.95 | $3.76 |
| Return (net of deductions per cwt.) | 4.30 | 4.30 |
| Net return or profit | 1,393.00 | 3,231.00 |
| Labor income at $1.25 per hour | 3,400.00 | 4,575.00 |
| Return to labor and management | 4,793.00 | 7,586.00 |
| Return per hour of labor | 1.73 | 2.17 |

3. Marginal cost of milk (added costs with fixed costs excluded) was estimated at $3.38 per cwt.; marginal costs other than labor were estimated at $2.59 per cwt.

4. Desirable herd size was influenced not only by economics related to dairy size but also by the combinations of dairying and farming involved.

Agr. Expt. Sta., U. Wyo., Laramie, Wyo. 82071

## Institutional, Educational, and Social Factors Affecting Conservation Application

See Also 269.

285. Kittle, J. R., Taylor, F. R., and Cox, R. W. A PILOT STUDY OF CERTAIN ASPECTS OF OUTDOOR RECREATION IN NORTH DAKOTA. N. Dak. Agr. Expt. Sta. B. 459, 39 pp. 1965.

Surveys of the visitors to North Dakota's recreation areas revealed that about one-fifth were on annual vacation and one-half were visiting North Dakota recreational areas for the first time. Almost one-third of the visitors were enroute to other recreation areas. The average length of stay at the different areas was between 2 and 3 days. The authors concluded that:

1. Simple outdoor recreation activities were the most popular.
2. Outdoor recreation opportunities were urgently needed near major highways, close to centers of population, and at the State's scenic and historic areas.
3. Outdoor recreation demands have increased and will continue to increase even faster than in the past.
4. The economic benefits of the tourist industry in North Dakota have not yet been fully measured or evaluated.
5. Tourism and outdoor recreation will be an increasingly important part in the economic growth of the State.
6. Increases in population, level of education, income, mobility, and leisure time, and other social-economic factors will result in increased demand for more outdoor recreation areas, activities, and opportunities.
7. Recreation visitors from out of State will play the major role in the use of the State's major parks, recreation areas, and attractions, whereas local visitors will be the most important at day use facilities located within 1 hour's drive or less of their homes.

Agr. Expt. Sta., N. Dak. State U., Fargo, N. Dak. 58103

286. Twardzik, L. F. EFFECTS ON PUBLIC POLICY OF FARM RECREATION DE-VELOPMENTS. J. Soil and Water Conserv. 20(3): 95-98. 1965.

Powerful governmental forces have been encouraging the use of farm resources for recreation development for a variety of reasons, including the need to develop the family farm community, increase the income of rural landowners, and control surplus crop production. These farm-based developments generally would be low investment, commercial recreation enterprises supplying opportunities for simple outdoor recreation activities.

Other governmental forces represented by public agencies--State, local, and Federal-- that are not engaged exclusively in the business of protecting or preserving unique areas,

but do provide similar recreation activities, are beginning to face each other as com-petitors  for public budget allocations. At the outset, the farmer or rural landowner thought he would be satisfied if he attracted only the surplus of users of public parks and forests, but neither human nature nor private enterprise will retain that posture for long.

The predictable result is that there will be a more direct competitive confrontation between government-stimulated private efforts and government-financed public recrea-tion programs. An active search for a meaningful cooperative effort between the public and private recreation sectors is the only answer to this dilemma.

Mich. State U., East Lansing, Mich.  48823

287.  McCurdy, D. R. THE FOREST RECREATION PROVIDER--WHO IS HE?  J. Soil and
      Water Conserv. 20(3): 99-100. 1965.

Small woodland owners in Ohio who provide outdoor recreation facilities to the public for a fee generally have similar backgrounds. They have experience in business, are not farmers, have at least a high school education, are less than 60 years of age, and are new-comers to the community. They also are active in their community and are outdoor enthusiasts. An avid interest in recreation, rather than a desire for windfall profits, usually is the major reason they offer outdoor recreation opportunities.

The average provider purchased land during the last 10 years specifically for outdoor recreational development. Because of high development costs, his land is mortgaged. His land holdings have several natural attractions and are located in a scenic setting.

North Central Expt. Sta., FS, USDA, St. Paul Campus, U. Minn., St. Paul, Minn.  55101

288.  Cushwa, C. T., McGinnes, B. S., and Ripley, T. H.  FOREST RECREATION: ESTI-
      MATES AND PREDICTIONS IN THE NORTH RIVER AREA, GEORGE WASHINGTON
      NATIONAL FOREST, VIRGINIA.  Va. Agr. Expt. Sta. B. 558, 47 pp.  1965.

The North River area of the George Washington National Forest was selected as the site to pilot test a stratified random sampling plan. Purposes were to provide unbiased estimates of important recreational uses on large units of forest land and to determine important socioeconomic use relations for predicting short-term user demand and needs.

A total of 1,532 households were interviewed at 18 exit points for information con-cerning use made of the 100-square-mile study area. Sampled values were used to arrive at an estimate of 833,314 man-hours of total use ($\pm$15 percent) with 691,837 man-hours for all types of recreation combined. Developed-site camping, hunting, sightseeing, and fishing were the most important forms of recreation in the area studied. Deer hunting provided by far the most hours of use.

The 859 interviews of households, with members participating in recreational ac-tivities, were examined for relations between socioeconomic factors and amounts and types of use made of the area.

The most important user attributes relating to participation in component activities were zone (or distance from the area), age, education, occupation, and income of the head of household. In addition, the average period of participation per visit varied considerably among groupings within certain socioeconomic attributes, which were the same as user attributes.

Results showed that a stratified random sampling plan could produce good estimates of total and component recreational uses. In addition, significant, important relations were detected between users and uses as a basis for providing decisions for present and future recreational management.

Va. Agr. Expt. Sta., Va. Polytech Inst., Blacksburg, Va.  24061.

289. U.S. Forest Service. OUTDOOR RECREATION IN THE NATIONAL FORESTS. U.S. Dept. Agr., Forest Serv., Agr. Inform. B. 301, 106 pp. 1965.

A detailed report was given on the outdoor recreation projects in the National Forests.

Photographs, tables, and maps.

FS, USDA, Inform. Div., Washington, D.C. 20250

# BIOLOGY

## Fish

See Also 288.

290. Banerjea, S., and Mandal, L. N. INORGANIC TRANSFORMATION OF WATER SOLU-BLE PHOSPHATE ADDED IN FISH PONDS AS INFLUENCED BY THE NATURE OF POND SOILS. J. Indian Soc. Soil Sci. 13(3): 167-173. Sept. 1965.

Influence of physico-chemical composition of pond soils on the rate of disappearance from water of added phosphate and the nature and magnitude of its transformation were studied with three different soils of acidic, neutral, and alkaline reaction.
Phosphate concentration in water declined rapidly for all of the three soils, the rate of decline showing a significant relation with composition of the soil. Soluble phosphate in water showed a higher concentration in acid soil than in neutral or alkaline soil.
The results of the fractionation of phosphate in the soils showed a marked increase in the aluminum phosphate, ferric phosphate, and calcium phosphate fractions in all the three soils. The ferric phosphate fraction was the highest in acidic soil, while the calcium phosphate fraction was the highest in alkaline soil. The increase in aluminum phosphate was nearly the same in all the soils. The total amount of phosphorus fixed in the soil was maximum in the alkaline soil and minimum in the neutral soil.

Cent. Indian Fisheries Res. Substation, Cuttack, Orissa, India.

291. Goodson, L. F., Jr. DIETS OF FOUR WARMWATER GAME FISHES IN A FLUC-TUATING, STEEP-SIDED, CALIFORNIA RESERVOIR. Calif. Fish and Game 51(4): 259-269. Oct. 1965.

A food habits study at Pine Flat Lake in 1963-64 revealed a seasonal abundance of cladocerans, chironomids, terrestrial arthropods, and threadfin shad in the diets of game fishes. Largemouth bass fed principally upon shad the year around, although small bass also ate cladocerans. Crappie ate mostly shad except in the spring, when small crappie ate chironomid larvae, cladocerans, and copepods. Catfish consumed chironomid larvae in the spring, shad in late summer and fall, and filaree, a terrestrial plant, in winter. Small catfish ate chironomid larvae from March through October. Bluegill ate all the seasonally abundant foods plus fish eggs in the spring.

Inland Fisheries Br., Calif. Dept. Game and Fish.

292. Christenson, L. M., and Smith, L. L. CHARACTERISTICS OF FISH POPULATIONS
        IN UPPER MISSISSIPPI RIVER BACKWATER AREAS. U.S. Dept. Int., Fish and
        Wildlife Serv., Bur. Sport Fisheries and Wildlife C. 212, 53 pp. 1965.

Standing crops of fish and their fluctuations from year to year, age and size class
structure of the populations, and growth rates of the common species present in three
backwater areas of the upper Mississippi River were determined during the period
1947-52 under the auspices of the Upper Mississippi River Conservation Committee.

Standing crops, as estimated from six collections following rotenone treatment of
blocked-off areas, ranged from 39 to 605 and averaged 248 pounds per acre.

Weight composition by species groups varied greatly among four collections made
in one study area, but was characterized by the following percentages: (1) Rough fish--38;
(2) non-game predaceous species--27; (3) panfish--13; (4) game fish--12; (5) catfish--11;
and (6) forage fish--1. Among the same four collections, the average composition in
pounds per acre was: (1) Rough fish--112; (2) non-game predaceous species--77; (3) pan-
fish--36; (4) game fish--29; (5) catfish--30; and (6) forage fish--2.

Very few fish over 5 years of age were found, and most of the game fish and panfish
were less than 3 years old.

Growth rates of most species were greater than most of those described in other
waters of the North Central States and in downstream areas of the Mississippi River.

Limited data on environmental factors were presented. Differences in standing crop
and species composition could not be related to changes in the water level.

U.S. Dept. Int., Fish and Wildlife Serv., Bur. Sport Fisheries and Wildlife, Washington,
D.C. 20240

293. Avault, J. W., Jr. PRELIMINARY STUDIES WITH GRASS CARP FOR AQUATIC
        WEED CONTROL. Prog. Fish Cult. 27(4): 207-209. Oct. 1965.

The grass carp appears to be one of the most promising fish species for biological
control of aquatic weeds. In addition to being effective for weed control, the fish are
hardy and can tolerate cold water. Further experimentation will be necessary to deter-
mine the effect of grass carp on fish populations, as well as desirable stocking rates.

To be widely useful, the grass carp must be induced to spawn, as natural spawning
has been reported only in certain areas of China, Japan, and Taiwan. Recently grass carp
have been spawned under artificial conditions.

Agr. Expt. Sta., Auburn U., Auburn, Ala. 36830

294. Walker, C. R. DIURON, FENURON, MONURON, NEBURON, AND TCA MIXTURES
        AS AQUATIC HERBICIDES IN FISH HABITATS. Weeds 13(4): 297-301. Oct. 1965.

The substituted urea herbicides were rated according to their effectiveness as
aquatic herbicides in this order: Diuron; monuron; neburon; and TCA mixtures with them.
They showed greatest potential in controlling certain aquatic plants in preemergence and
early postemergence applications. However, relatively high concentrations were required
to control filamentous algae (Cladophora, Pithophora, and Spirogyra), chara (Chara),
coontail (Ceratophyllum), naiad (Najas), and pondweeds (Pontamogeton) for periods of
time exceeding 3 months and up to 3 years. Granular formulations achieved better dis-
tribution of herbicides for control of rooted aquatic plants along the margins of lakes and
ponds. Wettable powder and liquid emulsifiable concentrates were superior to granular
formations for the control of algae and emergent or floating aquatic plants.

Monuron and fenuron were less toxic to fish than were diuron and neburon. The TCA mixtures were somewhat more toxic than the simple ureas. Some species of fish were more sensitive than others and fingerlings more sensitive than adults of the same species. Fish-food organisms were reduced appreciably outdoors with herbicidal concentrations in plastic enclosures.

Fish Control Lab., U.S. Dept. Int., Bur. Sport Fisheries and Wildlife, LaCrosse, Wis. 54601

295. Meyer, F. P. THE EXPERIMENTAL USE OF GUTHION AS A SELECTIVE FISH ERADICATOR. Trans. Amer. Fisheries Soc. 94(3): 203-209. July 1965.

Channel catfish fingerlings exhibited a greater tolerance of Guthion than four other species of fish in laboratory tests. Under field conditions, 13 other species of fish were effectively removed by 1.0 p.p.m. of Guthion without significant effects on catfishes. Differences in water quality and temperature did not affect the effectiveness of the chemical.

Food organisms were not permanently affected. Insect naiads were evident 10 days after treatments were applied. No difference in the abundance of zooplankters could be attributed to the application of the Guthion.

Fish killed by Guthion were not fit for consumption. Profound differences were noted between the residue levels in the flesh as compared to those in the offal of dressed fish. Offal contained up to 2.5 times as much residue as the flesh. Residue levels dropped sharply by the end of 1 week and were no longer detectable 6 weeks after exposure.

Bur. Sport Fisheries and Wildlife, Fish Farming Expt. Sta., Stuttsgard, Ark. 72160

296. Cope, O. B. SOME RESPONSES OF FRESH-WATER FISH TO HERBICIDES. South. Weed Conf. Proc. Annu. Mtg. 18: 439-445. 1965.

Studies on herbicides and fish have been intensified in the past 2 years. Work on acute toxicities has revealed that there are a few herbicides as toxic to some species of fish as are many chlorinated hydrocarbon insecticides. The influence of water hardness on toxicity of herbicides to fish has been studied in some laboratories; some results indicated greater toxicity in soft water, and others showed no influence of water hardness. Time and temperature studies showed large increases in toxicity with increases in water temperature and in time for some combinations of herbicide and fish species.

In the area of nonacute effects, pathology from sublethal exposures has developed with: Esters of 2,4-D and bluegills; silvex, and redear sunfish; casoron and bluegills; and sodium arsenite and bluegills. Changes in growth rates of warm-water fish were demonstrated following exposure to sublethal amounts of herbicides. Accumulation of residues of esters of 2,4-D and silvex, paraquat, casoron, diquat, and sodium arsenite have been measured in fish following exposures not causing mortality. Effects of herbicides on reproduction in fish have not been reported.

Fish-Pesticide Res. Lab., Bur. Sport Fisheries and Wildlife, Denver, Colo. 80225

297.  Barkalow, F. S., Jr., and Soots, R. F., Jr.  AN ANALYSIS OF THE EFFECT OF
        ARTIFICIAL NEST BOXES ON A GRAY SQUIRREL POPULATION.  Trans. North
        Amer. Wildlife and Nat. Resources Conf. 30: 349-360. 1965.

During the $8\frac{1}{2}$-year study, 2,242 individual gray squirrels captured in live traps,
nest boxes, and leaf nests were handled from 1 to 30 times each, and of these, 1,190 were
of known age ($\pm$1 week).
    The combined index values clearly indicated a higher population of squirrels on the
boxed plots.  The observations indicated that the increased survival of both the young and
adults was probably due to the greater protection from natural enemies, accidents, and
weather furnished by the boxes.
    The boxes may also reduce the dispersal rate of animals from the treated areas
as well as holding dispersing individuals which come from outside the area.

N.C. State, U. N.C., Raleigh, N.C.  27607

298.  Labisky, R. F., and Anderson, W. L.  CHANGES IN DISTRIBUTION AND ABUNDANCE
        OF PHEASANTS IN ILLINOIS: 1958 VERSUS 1963.  Trans. Ill. Acad. Sci. 58(2):
        127-135.  1965.

The relative abundance of pheasants in April, as reported by rural mail carriers in
the 74 northernmost counties of Illinois, increased from 7.8 birds per 100 miles of
driving in 1958 to 9.9 birds per 100 miles in 1963, or 27 percent. In both censuses,
pheasants were most abundant in east-central Illinois. Gains in pheasant abundance
between 1958 and 1963 occurred in east-central Illinois and immediately southwestward;
significant decreases in pheasant abundance occurred in the northern and northwestern
portions of the State.

Ill. Natl. Hist. Survey, Urbana, Ill.  61803

299.  Box, T. W.  BRUSH MANAGEMENT TECHNIQUES FOR IMPROVED FORAGE VALUES
        IN SOUTH TEXAS.  Trans. North Amer. Wildlife and Nat. Resources Conf.  30:
        285-296.  1965.

Much of south Texas rangelands is covered by a chaparral complex that is considered
relatively unpalatable to livestock and game animals. Large acreages of this brushland
are cleared annually by various techniques with the expressed goal of eradication of the
brush cover. Such complete removal of brush not only destroys game habitat but removes
the woody species as forage plants.
    During the summer of 1963, five treatments of commonly used brush techniques were
established on clay and sandy loam soils of the Rob and Bessie Welder Wildlife Refuge in
Texas in order to study the relative merits of brush management techniques. Methods
used were mowing, roller chopping, clearing with a bulldozer and K-G blade, root-
plowing, and root-plowing and raking.
    All methods reduced cover significantly. The root-plowed areas and the root-plowed
and raked plots reduced the brush population to the point where it had no significant value
for forage. Mowing of brush on clay soils increased forage values 8-fold over the check,
roller chopping increased brush forage values 6-fold, and removing with a K-G blade

increased forage values 4-fold. On sandy loam soils, roller chopping and K-G blade removal of brush increased its value almost 2-fold, root-plowing and root-plowing and raking reduced forage values almost to zero.

Browse preference values were increased on all species of woody plants by treatments used. Highest preference values were for plants that resprouted vigorously after their tops had been removed.

Brush management, or control of woody plants, appears to be more desirable from a livestock-game standpoint than attempted eradication of brush on south Texas ranges. Removal of brush tops by relatively inexpensive methods increased forage values and preference ratings of brush plants.

Welder Wildlife Found., Sinton, Tex. 78387

300. Smith, A. D., Beale, D. M., and Doell, D. D. BROWSE PREFERENCES OF PRONG-HORN ANTELOPE IN SOUTHWESTERN UTAH. Trans. North Amer. Wildlife and Nat. Resources Conf. 30: 136-141. 1965.

Browse preference was studied when 6 antelope were fed 16 species of browse plants common on desert ranges of Utah for 6 days. Ample amounts of all species were available.

Three species, big sagebrush, black sagebrush, and juniper, provided the major part of the diet. More than half was provided by big sagebrush.

Nutrient values of the diet were computed using digestion coefficients determined with mule deer and sheep. The values thus obtained were well in excess of accepted standards for domestic sheep.

Unless competition from livestock seriously reduces the volume of sagebrush available to antelope, a low plane of nutrient during winter does not appear to be a factor in the productivity of this species in western Utah.

Utah State U., Logan, Utah. 84321

301. Jordan, J. S., Hagar, D., and Stiteler, W. M., Jr. DEER-BROWSE PRODUCTION AND TIMBER-STAND IMPROVEMENT IN NORTHERN HARDWOODS. Trans. North Amer. Wildlife and Nat. Resources Conf. 30: 296-305. 1965.

Opportunities for coordinating timber and habitat management in northern hardwoods should increase with the growing acceptance of even-aged management. A large proportion of northern hardwood stands are now even-aged. Much of this is in poletimber size--generally of low value for most wildlife. The key to coordination is in the cutting methods--and in the size, distribution, and cycles of cutting--used to obtain a better balance in age classes and an orderly turnover of stands.

A method of intermediate cutting to increase the production of deer browse and improve small game food and cover is currently in use in poletimber stands on the Allegheny National Forest. The method was tested for its yield of woody deer browse in 40- to 60-year-old Allegheny hardwoods. Felling all stems except the crop trees produced a total of 141,000 twigs of browse per acre in the first year. Tops in the same winter as felling yielded 98,000 twigs per acre.

Browse production expressed as number of twigs per acre was preferred for a variety of reasons. The method has a number of specific uses. Its most efficient use in resource planning will be realized when integrating the needs of wildlife in the over-all compartment planning.

Northern Expt. Sta., FS, USDA, Warren, Pa. 16365

302. Dietz, D. R. DEER NUTRITION RESEARCH IN RANGE MANAGEMENT. Trans. North Amer. Wildlife and Nat. Resources Conf. 30: 274-285. 1965.

Several nutritional studies on deer ranges in Colorado were summarized. Important findings included the following: (1) Clipping intensity did not affect nutritional value of plants; (2) plants were generally higher in nutrients during the growing season than during the dormant season; (3) the leaves of plants contained higher percentages of nutrients than the stems; (4) summer range plants were generally more nutritious than winter range plants; (5) browse species were more completely digested by deer when fed alone than in mixtures; and (6) there were no significant differences among experimental deer in their ability to digest the nutrients of browse species.

Uses of nutritional data were proposed and discussed, and some methods of increasing nutritional levels in range forages were suggested.

Rocky Mountain Forest and Range Expt. Sta., FS, USDA, Rapid City, S. Dak. 57701

303. Bookhout, T. A. FEEDING COACTIONS BETWEEN SNOWSHOE HARES AND WHITE-TAILED DEER IN NORTHERN MICHIGAN. Trans. North Amer. Wildlife and Nat. Resources Conf. 30: 321-335. 1965.

Feeding coactions between white-tailed deer and snowshoe hares in northern Michigan were studied during 2 winters to determine the extent to which the animals competed for food. The investigation was made in a portion of a long-used deer yard. Approximately 134 deer were present in the 1959-60 winter and 167 in the 1960-61 winter. Estimated hare populations were 99, at the high of the cycle, and 31, after the cyclic decline had begun, for the same periods, respectively. Analyses of browsing showed that deer removed 5.8 to 6.8 percent of the total browse available in the first and second winters, respectively. At their cyclic high, hares removed about 19 percent as much browse as did deer on a per-acre basis. Overall, competition was not significant for any single food item available in quantity. For the entire study area, white cedar was the most heavily used species, but combined browsing removed only 4.0 to 4.5 percent of the available twigs in both winters. Hares appeared to play a decidedly minor role in the removal of browse from the deer yard under study.

Ohio Coop. Wildlife Res. Unit., Columbia, Ohio.

304. Weeden, R. B. BREEDING DENSITY, REPRODUCTIVE SUCCESS, AND MORTALITY OF ROCK PTARMIGAN AT EAGLE CREEK, CENTRAL ALASKA, FROM 1960 to 1964. Trans. North Amer. Wildlife and Nat. Resources Conf. 30: 336-348. 1965.

Initial breeding of stocks of rock ptarmigan (Lagopus mutus) on a 15-square-mile area in east-central Alaska rose from 88 cocks in 1960 to a peak of 170 in 1962, then declined to 109 in 1964. Good chick production for 2 years was followed by 3 years of lower production. Clutch size decreased significantly from 1960 (average clutch 8.2) to 1963 and 1964 (average clutch 6.5 and 6.6), but predation on nests by weasels (Mustela erminea) accounted for most of the deceased production in 1962-64. Early survival of chicks did not vary greatly. Mortality from late summer to spring was only 40 to 46 percent for all ages in 1960-61, but death rates rose in 1961-62 and 1962-63 to 64 to 67 percent. Overall mortality was 53 to 57 percent in the winter of 1963-64, with a very high loss of young birds balanced by excellent survival of adults, especially hens.

Alaska Dept. Game and Fish, Fairbanks, Ala. 99701

305. Triner, E. J., and Klimstra, W. D. EFFECTS OF BURNING AND FALLOWING OF
VEGETATION. Trans. Ill. State Acad. Sci. 58(2): 102-114. 1965.

During 1954 and 1955, a study of the effects of burning and fallowing on idle land was
conducted on property of the United Electric Coal Companies, Inc., near DuQuoin, Ill.
    The plant families Rubiaceae, Gramineae, Juncaceae, and Polygonaceae decreased
in number as a result of burning; increases were recorded for the Compositae, Euphor-
biacea, and Leguminosae. Plants showing major increases were: Lanceleaf ragweed
(Ambrosia bidentata); three-seeded mercury (Acalypha virginica); wild beans (Stro-
phostyles spp.); annual lespedezas (Lespedeza spp.); and panic grasses (Panicum spp.).
Decreases were recorded for: Buttonweed (Diodia teres); rush (Juncus spp.), sheep sor-
rel (Rumex acetosella); perennial rye grass (Lolium perenne); goldenrods (Solidago spp.);
and broomsedge (Andropogon virginicus). Bare ground was increased about eight times
and soil pH was changed from 6.9 to 7.4.
    Fallowing resulted in an increase in Gramineae, Rubiaceae, Rosaceae, Solanaceae,
and Zizoaceae; decreases were noted for the Compositae, Euphorbiaceae, Juncaceae,
and Leguminosae. Bare ground was increased 14 times; the soil pH was unchanged.
Burning and fallowing resulted in diversified habitats suitable for optimum quail
utilization.

Carl Sandburg High School, North Riverside, Ill. 60546

306. Ehrenreich, J. H. EFFECTS OF TIMBER HARVEST AND STAND IMPROVEMENT
ON FORAGE PRODUCTION. J. Wildlife Mangt. 29(4): 734-739. Oct. 1965.

Production of understory vegetation was measured on undisturbed areas and on areas
having logging and timber stand improvement during the past 10 years on National Forest
lands in southern Missouri. There was an increase in vegetative production following log-
ging and stand improvement, especially in the pine (Pinus echniata) forest type. Increases
were not, however, as great as anticipated. The type of timber management practiced in
the Ozarks during the past 10 years has created small openings which did not appreciably
reduce the overall crown cover or basal area; thus, forage production on the area as a whole
was not greatly increased. More intensive removal of overstory was recommended to obtain
maximum increases in forage.

Mo. Conserv. Comn., Columbia, Mo. 65201

307. U.S. Department Interior. SURVIVAL OR SURRENDER FOR ENDANGERED WILDLIFE.
Bur. Sport Fisheries and Wildlife. C. 223, 15 pp. $0.15. 1965.

A pictorial report was given on the different species of wildlife that are becoming
extinct.
    Measures necessary to save these animals were discussed.

For Sale, Supt. Doc., U.S. Govt. Print. Off., Washington, D.C. 20402

308. Azevedo, J. A., Jr., HUNT, E. G., and WOODS, L. A., Jr. PHYSIOLOGICAL EFFECTS
OF DDT ON PHEASANTS. Calif. Fish and Game 51(4): 276-293. Oct. 1965.

The effects of DDT on penned pheasants were studied in California. The insecticide
was offered to test birds in pelleted and wheat diets. Diets were contaminated at levels
of 10, 100, and 500 p.p.m. DDT.

Data were obtained on the influence of the contaminated diets on egg production, fertility, and hatchability and the survival rate of chicks. Chronic toxicity of the DDT diets to breeding pheasants was recorded.

Results demonstrated that 500 p.p.m. diets were highly toxic to breeder pheasants. All hens fed DDT-contaminated diets passed residues into their eggs. Egg production, fertility, and hatchability were not affected at the contaminated diet levels fed. Chick mortalities were highest among young from parents receiving 500 p.p.m. diets. Evidence was obtained suggesting that DDT residue levels in the brain may be used as an indicator of DDT intoxication in pheasants.

Game Mangt. Br., Calif. Fish and Game.

309. Richens, V. B. AN EVALUATION OF CONTROL ON THE WASATCH POCKET GOPHER. J. Wildlife Mangt. 29(3): 413-425. July 1965.

Pocket gopher (Thomomys talpoides) control was applied to areas of subalpine range of northern Utah over 1-, 2-, 3-, and 4-year periods. A nearby range that was infested with pocket gophers was used as an untreated check. The control consisted of hand-baiting gopher tunnels with whole oats treated with 0.125 percent sodium fluoroacetate (Compound 1080). A gopher population-per-acre index was determined for each of five treatments (0, 1, 2, 3, and 4 years' control) by saturation trapping on trap blocks for a 3-day period. The gopher population was reduced about half by the first year's control. Additional years of control, however, failed to significantly reduce the gopher population further.

Only tunnels under new mounds were treated in the control program.

Treatment of tunnels under old mounds, as well as new, could have increased the effectiveness of control as much as 20 to 30 percent. Periodic and cumulative mound counts showed good positive correlations ($r=0.83$;$r=0.82$) with the gopher population index, but counts of the numbers of mounds formed in a 72-hour period did not ($r=0.41$). Winter cast counts in early July showed a correlation of 0.80 with the gopher population index. The gopher population index had a good correlation with bulbed plant abundance but was poorly correlated with perennial plant yield and annual plant abundance.

The cost of gopher control averaged $1.13 and $0.51 per acre per year for initial treatment and retreatment, respectively.

Utah Coop. Wildlife Res. Unit, Logan, Utah. 84321

310. Goodhue, L. D., and Baumgartner, F. M. APPLICATIONS OF NEW BIRD-CONTROL CHEMICALS. J. Wildlife Mangt. 29(4): Oct. 1965.

A new approach for the control of nuisance and depredatory birds is offered by the use of chemically-treated baits which produce flock-disturbing reactions. Physiological effects involving unusual actions and calls disturb and warn unaffected birds of impending danger. These birds are thus induced to abandon the area.

The two most effective chemicals found so far are 4-nitropyridine-N-oxide (Avitrol 100) and 4-aminopyridine (Avitrol 200). These chemicals were toxic when ingested in sufficient amounts, but the mortality was controlled by adjusting the concentration in the bait. One highly desirable feature was the lack of secondary poisoning by these chemicals.

Excellent results were obtained on sparrows (Passer domesticus), pigeons around buildings, and starlings (Sturnus vulgaris) in feedlots. Good preliminary results were obtained in tests against birds in standing grain. Gulls on airports responded to this

method. Crows (<u>Corvus</u> <u>brachyrhynchos</u>) were driven from the environs of an airport in a single test. Where treated baits were left in suitable feeders, control of pigeons and sparrows were effective for more than a year.

Phillips Petroleum Co., Bartlesville, Okla. 74003

# Wetland Wildlife

311. Knudsen, G. J., and Hale, J. B. MOVEMENTS OF TRANSPLANTED BEAVERS IN WISCONSIN. J. Wildlife Mangt. 29(4): 685–688. Oct. 1965.

From 1951 to 1957, 2,200 beavers (<u>Castor</u> <u>canadensis</u>) in north and central Wisconsin were livetrapped, ear-tagged, and moved to new release sites. Recaptures totaled 472. Mean movement distances of recaptured beavers transplanted to streams were more than twice as long as for beavers transplanted to potholes and lakes. This relationship held true for both sexes. Landlocked waters were recommended as the best release sites for transplants.

Wis. Conserv. Dept., Madison, Wis.

312. Brakhage, G. K. BIOLOGY AND BEHAVIOR OF TUB-NESTING CANADA GEESE. J. Wildlife Mangt. 29(4): 751–771. Oct. 1965.

A 3-year study (1961–64) of a sedentary flock of Canada geese (<u>Branta</u> <u>canadensis</u> <u>maxima</u>) was reported. Most pairs nested in elevated wash tubs which provided protection from predators during the laying period. Ten percent of yearling males nested. Females became productive in their second year with one-third of them nesting. Ninety percent or more of males 2 years and older and females 3 years and older paired. Polygamy was not uncommon. Nesting territories were selected by the females and defended primarily by the males. Females had an affinity for their nest sites in subsequent years. The rate of laying was one egg each 1-1/2 days. There was a direct relationship between age of females and initiation of laying; older females nested first.
Eggs of <u>maxima</u> were similar to those of other subspecies. Egg size was related to age of females; 5-year-old birds laid the largest eggs. Down appeared most often with the fourth egg. Clutches of successful tub-nesting females averaged 5.5 eggs while successful ground-nesting females averaged 4.6 eggs. Older females laid larger clutches and hatched a larger percentage of their eggs than did younger females. The duration of breeding season was influenced primarily by renesting. Females incubated 28 days. Females incubated dead eggs 1.5 times normal length. Goslings were held in the tubs about 24 hours after hatching and became inprinted to their parents. Broods were called from the tubs by their parents, and the nesting territory was abandoned as the new family swam away.
Renests were of two types: Continuation nests, which were located an average of 96 yards from destroyed nests; and true renests, which were located an average of 243 yards away.
Seventy-three percent of incubated eggs hatched, 5 percent were infertile, and 22 percent died during incubation. Broods retained their identity for about 7 days, then gradually formed creches of increasing size. Gosling mortality averaged 32 percent.

Mo. Conserv. Comn., Columbia, Mo. 65201

313. Kear, J. THE INTERNAL FOOD RESERVES OF HATCHING MALLARD DUCK-
     LINGS. J. Wildlife Mangt. 29(3): 523-528. July 1965.

Late embryonic and postembryonic weight changes in the yolk sac and lives of mal-
lard ducklings (Anas platyrhynchos) from Slimbridge, England, were reported. The
amount of yolk which remained after hatching was thought to depend in part on heredity
and in part on the speed of the hatching process. Yolk was mostly used up during hatching
and in the first day of life and was, therefore, an important food store after ducklings
left the nest. During the second day, the yolk sac decreased at much the same rate in fed
and unfed birds. Birds without food for the first 48 hours were in good condition and
apparently existed mainly on their body fat reserves. Liver weight increased as yolk
decreased before and immediately after hatching, although the birds did not feed.
At 2 weeks, this organ was relatively enormous and some proportional decrease must
occur as the mallard matures.

The Wildfowl Trust, Slimbridge, Gloucestershire, England

314. Gates, J. M. DUCK NESTING AND PRODUCTION ON WISCONSIN FARMLANDS.
     J. Wildlife Mangt. 29(3): 515-523. July 1965.

Duck-nesting studies were made from 1959 through 1963 on a 7-square-mile study
area in east-central Wisconsin. Breeding populations of mallards (Anas platyrhynchos)
and blue-winged teals (A. discors) combined averaged 7.6 pairs per square mile per
year. Wetlands and hayfields were the primary cover types used for nesting. Total hatch-
ing success was 32 percent for the 5-year period. Production was estimated to average
about four broods per square mile per year. Low brood survival, associated with a defi-
ciency of adequate brood habitat, appeared to be an important limitation to duck production
in 4 of the 5 years of the study.

Wis. Conserv. Dept., Waupun, Wis. 53963

315. Hartung, R. SOME EFFECTS OF OILING ON REPRODUCTION OF DUCKS.
     J. Wildlife Mangt. 29(4): 872-874. Oct. 1965.

After ingestion of 2 gm./kg. of a relatively nontoxic lubricating oil, one mallard
(Anas platyrhynchos) and two Pekins ducks stopped laying for about 2 weeks. Very small
quantities of oil coated on mallard eggs reduced their hatchability to 21 percent compared
to 80 percent for unoiled mallard eggs. Experimentally oiled mallards continued incubat-
ing their clutches, but their eggs did not hatch even though they continued incubation for
longer than normal periods.

U. Mich., Ann Arbor, Mich. 48104

316. Knight, R. R. VEGETATIVE CHARACTERISTICS AND WATERFOWL USAGE OF A
     MONTANA WATER AREA. J. Wildlife Mangt. 29(4): 782-788. Oct. 1965.

During the summers of 1956 and 1959, a study was conducted to determine changes
in characteristics of vegetation and waterfowl usage of a pond area in Teton County, Mont.
Aquatic vegetation increased on the area during that time, with growth in sago pondweed
(Pontamogeton pectinatus), stonewort (Chara vulgaris), and alkali bulrush (Scirpus
paludosus) the most significant. Changes in portions of the terrestrial vegetation were
noted; one such change was accompanied by an increase in nesting. Total numbers of

waterfowl and number of species and nests increased during the study period. An apparent decrease in brood usage may have been the result of the difficulty of observing waterfowl in denser vegetation during the second year.

Mont. Fish and Game Dept., Augusta, Mont. 59410

317. Weller, M. W., and Spatcher, C. S. ROLE OF HABITAT IN THE DISTRIBUTION AND ABUNDANCE OF MARSH BIRDS. Iowa Agr. Expt. Sta. Sp. Rpt. 43, 31 pp. 1965.

Severe drouth during the 1950's produced dramatic changes in the vegetation of midwestern glacial marshes and in the abundance and distribution of marsh birds. Changes in marsh habitat quality and quantity were studied in relation to bird populations in two small central Iowa marshes near Jewell, Iowa. General observations were made on several larger marshes in northwest Iowa near Ruthven.

These marshes were nearly dry in 1956 and became densely vegetated. With gradually rising water levels, plants flourished and bird populations increased. During dry periods, only adaptable species such as redwinged blackbirds were present. As water levels increased, densely vegetated areas were opened up by muskrat cutting, and yellowheaded blackbirds, coots, pied-billed grebes, and least bitterns became established and increased in numbers. Maximum bird numbers and diversity were reached when a well-interspersed cover-water ratio of 50:50 occurred. By 1962, muskrats and high water had eliminated virtually all emergent vegetation with the result that all species except redwings were eliminated.

Habitat changes permitted a measure of habitat preference and adaptability in several species. Redwings used shoreward vegetation and were the most tolerant of changing conditions. They utilized a higher percentage of brush and tree nest sites over land as emergent vegetation disappeared. Yellow-headed blackbirds were restricted to robust emergent vegetation standing in water but used only those areas adjacent to open water.

Coots and pied-billed grebes both nested over water in cover of medium density with sizable adjacent water openings.

Black terns selected low, natural nest sites or built nests low to the water in sparce emergent vegetation where they were protected from wave action. Forster's terns nested on higher sites.

Marshes are highly productive ecosystems characterized by dramatic short-term fluctuations. There are periodic invasions of terrestrial flora and fauna during dry years, while wet years produce a pond or lake-type community.

Agr. and Home Econ. Expt. Sta., Iowa State U. Sci. and Tech., Ames, Iowa. 50010

318. Yeo, R. R. LIFE HISTORY OF SAGO PONDWEED. Weeds 13(4): 314-320. Oct. 1965.

A 4-year study was made of sago pondweed at Huntley, Mont. When the seed coats were ruptured, 100 percent germination of sago pondweed (Potamogeton pectinatus L.) seeds occurred. Tubers grew in soil to a depth of 18 inches. Formation of tubers was greatest in August. Single plants of sago pondweed, grown from a tuber and a seed, in 6 months developed over 36,000 tubers and 63,000 seeds, respectively. Tubers survived winter temperatures well when buried in the soil. When dipped in paraffin, tubers survived up to 4 years in storage.

CRD, ARS, USDA, U. Calif., Davis, Calif. 95616

319. Teeter, J. W. EFFECTS OF SODIUM CHLORIDE ON THE SAGO PONDWEED. J. Wildlife Mangt. 29(4): 838-845. Oct. 1965.

Sago pondweed plants (<u>Potamogeton pectinatus</u> L.) at several stages of growth were subjected to various NaCl solutions to determine the influence of the NaCl concentrations on the plant growth and reproduction. Data indicated that the tap water treatment produced maximum vegetative growth and seed production. Increasing NaCl solutions produced a proportional adverse effect upon the vegetative growth and seed production, but an NaCl concentration of 3,000 p.p.m. stimulated the production and growth of tubers. Saline conditions above 9,000 p.p.m. NaCl completely inhibited the growth of 1-week-old plants. Plants which were 4 to 8 weeks of age could produce new growth in NaCl concentrations of 12,000 p.p.m., but a concentration of 15,000 p.p.m. reduced growth completely and proved fatal to many plants.

The tap water treatment was shown to produce the maximum seed germination success, and an NaCl concentration of 3,000 p.p.m. reduced the germination success by 50 percent. Concentrations above 15,000 p.p.m. NaCl inhibited germination, but a 15 percent germination success could be obtained if the seeds were placed in tap water following the NaCl treatment for 28 days.

Utah Coop. Wildlife Res. Unit, Utah State U., Logan, Utah. 84321


# SUPPLEMENT

## Problems Indirectly Affecting the Application of Soil and Water Conservation Practices

320. Stewart, D. K. R., Chrisholm, D., and Fox, C. J. S. INSECTICIDE RESIDUES IN POTATOES AND SOIL AFTER CONSECUTIVE SOIL TREATMENTS OF ALDRIN AND HEPTACHLOR. Canad. J. Plant Sci. 45(1): 72-78. 1965.

Aldrin or heptachlor at 5 and 10 lb./acre were each incorporated into a sandy loam soil in 1958-60. In 1963, the soils and potatoes grown there were analyzed for insecticide residues by electron capture gas chromatography.

Soils which had received applications of heptachlor contained an appreciable amount of gamma-chlordane in addition to heptachlor and heptachlor epoxide. Gamma-chlordane, a constituent of commercial formulations of heptachlor, was more persistent in soil than heptachlor, and the heptachlor to gamma-chlordane ratio decreased with time. Soils to which a total of 30 lb. acre of commercial heptachlor had been added were found to contain up to 2.1 p.p.m. gamma-chlordane, 2.0 p.p.m. heptachlor, and 0.8 p.p.m. heptachlor epoxide. Soils treated with the same amount of aldrin contained up to 0.8 p.p.m. aldrin and 2.3 p.p.m. dieldrin.

Potatoes grown in these soils contained up to 0.017 p.p.m. heptachlor, 0.06 p.p.m. heptachlor epoxide, 0.016 p.p.m. gamma-chlordane, 0.002 p.p.m. aldrin, and 0.03 p.p.m. dieldrin of the total fresh weight. Heptachlor, aldrin, and gamma-chlordane were not present in the pulp in appreciable amounts. Approximately 50 percent of the total residue was contained in or on the skin of the tuber.

Res. Sta., Canada Dept. Agr., Kentville, Nova Scotia, Canada.

321. Neiswander, R. B. INSECT AND MITE PESTS OF TREES AND SHRUBS. Ohio Agr. Res. and Develop. Cent. Res. B. 983, 54 pp. 1966.

Information was given to aid home gardeners, nurserymen, and commercial arborists in identifying specific insect pests of trees and shrubs so that control measures can be employed more intelligently. Photographs and short descriptions were included, as well as important features of the habits and life histories.

Many species of insects and mites occur only occasionally on trees and shrubs. Others may occur often but never cause significant damage. These were not included in this publication, which was limited to pests destructive in Ohio.

Ohio Agr. Res. and Develop. Cent., Wooster, Ohio. 43210

322. Burnside, O. C., Wicks, G. A., and Fenster, C. R. HERBICIDE LONGEVITY IN NEBRASKA SOILS. Weeds 13(3): 277-278. July 1965.

At Lincoln, 20 lb./acre of 2,3,6-TBA destroyed Clark soybeans 5 seasons after application. Soil persistence of 2,3,6-TBA in the light textured soils and low rainfall of western Nebraska was less than at Lincoln. A 10-lb./acre rate of monuron reduced weed and oat yields at Lincoln the third growing season after its application. Applications of atrazine, simazine, or monuron at 10 lb./acre reduced oat yields at North Platte the third growing season after their application. Herbicide carryover is a greater problem in arid than in humid regions of the United States.

U. Nebr., Lincoln, Nebr. 68503

323. Burnside, O. C. LONGEVITY OF AMIBEN, ATRAZINE, AND 2,3,6-TBA IN INCUBATED SOILS. Weeds 13(3): 274-276. July 1965.

Herbicides incubated in Wymore silty clay loam soil at field capacity at 15, 25, and 35° C. showed amiben to be the most persistent; 2,3,6-TBA intermediate; and atrazine the least persistent to microbial and/or chemical breakdown. All herbicides persisted much longer at 15° than at 35° C. The average annual temperature below the plow layer was about 12° C. This helped to explain the persistence of leached herbicides under field conditions.

U. Nebr., Lincoln, Nebr. 68503

324. Donaldson, T. W., and Foy, C. L. THE PHYTOTOXICITY AND PERSISTENCE IN SOILS OF BENZOIC ACID HERBICIDES. Weeds 13(3): 195-201. July 1965.

In nutrient solution, 2,3,6-TBA was less toxic to oats than either dicamba or amiben. The last two herbicides were similar in phytotoxicity.

In soil, dicamba was the most phytotoxic in each of four soils used, while 2,3,6-TBA and amiben were similar in toxicity in all soils except the organic soil, in which amiben was less phytotoxic than 2,3,6-TBA. In the sandy soils, the same amount of herbicide was required to reduce the growth of oats by 50 percent as was required in nutrient solution, but considerably higher amounts were required in the organic soil. This reduction in phytotoxicity was attributed to adsorption of the herbicides in an unavailable form by the organic matter of the soils, amiben being adsorbed to a greater extent than 2,3,6-TBA or dicamba. Practically no adsorption occurred on the clay colloids of the various soils.

In persistence studies, amiben was more subject to apparent microbial decomposition than 2,3,6-TBA or dicamba. Decomposition was more rapid in the organic soil than in the clay or sandy soils. In leaching studies, the three herbicides were readily washed out of columns of the various soils. Differences in movement of herbicide in these soils could be related to the rate of water movement through the soil.

Jr. Author, U. Calif., Davis, Calif. 95616

325. Dubey, H. D., and Freeman, J. F. LEACHING OF LINURON AND DIPHENAMID IN SOILS. Weeds 13(4): 361-362. Oct. 1965.

Linuron and diphenamid were applied at 5 and 25 lb./acre to 13- $\times$ 3-inch columns of Wheeling sandy loam and Maury silt loam soils and leached with 1, 2, 4, and 8 inches of water. Linuron remained at or near the soil surface; diphenamid was leached more readily.

Agr. Expt. Sta. U. Puerto Rico, Rio Piedras, Puerto Rico. 00928

326. Nearpass, D. C. EFFECTS OF SOIL ACIDITY ON THE ADSORPTION, PENETRA-TION, AND PERSISTENCE OF SIMAZINE. Weeds 13(4): 341-346. Oct. 1965.

In 1:1 slurry, adsorption of simazine by acid soils from saturated solution varied from 13 to 90 percent. Percent of adsorption from more dilute solutions was approximately that from the saturated solution. The adsorption of simazine by 18 soils was not correlated significantly with soil pH but was correlated significantly with percent clay and highly significantly with organic matter and titratable acidity. Simazine was considered to be adsorbed by soils by proton association. Using titratable acidity as a measure of H-soil, equilibrium constants were calculated which did not vary greatly as a result of changes in acidity up to pH 8.5 or as a result of concentration of simazine in the added solution.

Leon, the most adsorptive of the tested soils, gave values for the equilibrium constant that were somewhat higher than for four other soils.

Simazine penetrated more deeply into limed soil than into unlimed soil. Liming reduced the decomposition of simazine as did intermittent drying. Recovery decreased with time.

SWCRD, ARS, USDA, Beltsville, Md. 20705

327. Isakov, D., and Trifunovic, D. THE EFFECT OF ADDING LARD TO MIXTURES FOR FATTENING BROILERS. J. Sci. Agr. Res. (Translated from Arhiv Za Poljoprivredne Nauke) 17(58): 83-90. 1964.

The results of an experiment on the effect of adding lard to feed mixtures for fattening broilers were:

1. The addition of 2, 3, and 4 percent lard had a favorable effect on both the weight gain and the feed efficiency. The highest percentage of weight gain more than the control was 5.12 percent that was achieved in the first test with a mixture with 4 percent fat. Along with this, the feed efficiency was improved by 5.99 percent. In the second test, with different caloric and protein values, the highest weight gain was again in the group which got 4 percent added fat. However, the increase of weight gain in this group was only 3.47 percent compared with the control, but the feed efficiency was higher by 7.87 percent.

2. The groups whose ration had 4 percent fat and nearly the same calorie-protein ration value had the best carcass quality--over 90 percent were classed as grade I. In the second test, where besides the fat there was an increased calorie-protein ratio, the best "slaughter value" was shown by the control.
3. The addition of fat had an unfavorable effect on the cost of the feeds.
4. The added fat had a somewhat better effect on the weight gain during the first half of fattening, while with the feed efficiency the case was the reverse.
5. The addition of fat had the same effect on male and female chickens.
6. Mortality of chickens did not exceed the permissible limit.
7. The addition of 4 to 6 percent fat was justified only when the price of lard was low.

No address given.

328. Velasco, M., Schoner, C., Jr., and Lofgreen, G. P. COMPOSITION AND FEEDING VALUE OF ALMOND HULLS AND HULL-SHELL MEAL. Calif. Agr. 19(3): 12-14. 1965.

More than $1,000,000 worth of almond hulls have been marketed annually by California almond growers in recent years. This by-product of the almond industry is used mainly by livestock producers in beef cattle feeding operations. New methods of processing almonds have resulted in a feed by-product now consisting of almond hull and shell mixtures. Hull-shell meal supplied little or no protein and was a poor source of phosphorus and fat. However, the hull-shell mixtures were high in nitrogen-free extract, sugars, and potassium. The money value of Nonpareil variety almond hull-shell meal containing an average of 18 percent fiber was about 58 percent that of barley.

G. P. Lofgreen, U. Calif., Davis, Calif. 95616

## Radioactive Fallout

329. Evans, E. J., and Dekker, A. J. INFLUENCE OF RATE OF $Sr^{90}$ ADDED TO SOIL AT DIFFERENT PHOSPHATE LEVELS ON THE CONCENTRATION OF $Sr^{90}$ IN PLANTS. Canad. J. Plant Sci. 45(4):375-381. July 1965.

A greenhouse experiment was designed to show the effects of monocalcium phosphate and rate of Sr-90 added to soil on the concentration of Sr-90 in oats and alfalfa. A reduction in Sr-90 concentration in oats of about 50 percent was effected on Grenville soil by the addition of 0.546 g. P per 2 1/2 kg. soil. It was believed that the reduction was caused partly by the effect of calcium in the fertilizer and partly by the dilution caused by a very large increase in yield from the application of the fertilizer. Similar reductions in Sr-90 concentration were not found for alfalfa. A wetting and drying pretreatment of the soil caused slight decreases in Sr-90 concentration in alfalfa but not in oats.

In one series of treatments, Sr-90 was added to the soils in doses ranging 1,000-fold in concentration. The concentration of Sr-90 in oats and alfalfa was generally proportional to applied dose, although it was found in some instances to be proportionately higher at the lowest dose added to soil.

Soil Res. Inst., Canada Dept. Agr., Ottawa, Ontario, Canada.

330. Evans, E. J., and Dekker, A. J. Sr$^{90}$ CONCENTRATION IN DEEP- AND SHALLOW-ROOTING SPECIES AS AFFECTED BY PLACEMENT OF Sr$^{90}$ AND FERTILIZER IN THE SOIL. Canad. J. Soil Sci. 45(3): 289-296. Oct. 1965.

In greenhouse experiments, marked reductions in Sr-90 concentration were found for timothy and wheat when the Sr-90 was placed deep in the soil compared with the results found for shallow placement. Fertilization of the soil above the zone of Sr$^{90}$ contamination led to further decreases in Sr-90 concentration in timothy and wheat.

Results for alfalfa differed from the results for timothy and wheat. A combination of shallow fertilization and shallow placement of Sr-90 caused the highest concentration of Sr-90 in plants. Deep placement of Sr-90 did not reduce the Sr-90 concentration in the first cutting of alfalfa, but as the plant matured, there was a reduction caused by deep placement of Sr-90. Deep placement of Sr-90 combined with deep placement of fertilizer caused an increase in the Sr-90 concentrations in alfalfa compared with deep placement of Sr-90 alone. The greatest reductions in Sr-90 in the plants were found where the deep placement of Sr-90 was combined with shallow placement of the fertilizer. Surface or subsurface watering of the crop did not affect the main conclusions with regard to placement of Sr-90 and fertilizer.

Soil Res. Inst., Canada Dept. Agr., Ottawa, Canada.

331. Huff, F. A. RADIOACTIVE RAINOUT RELATIONS ON DENSELY GAGED SAMPLING NETWORKS. Water Resources Res. 1(1): 97-108. 1965.

Studies were made of the relationship between the rainout of radioactivity in convective storms and three rainfall factors: Rainfall volume; storm duration; and rainfall rate. Data were used from four densely gaged sampling networks operated during the spring and summer of 1962-64 in central Illinois. The network areas ranged from 10 to 6,000 square miles and provided data on both microscale and mesoscale relationships. Analyses of spatial variability showed a trend for the relative variability of rainout to: (1) Exceed the storm rainfall variability; (2) decrease with increasing rainfall volume and storm duration; and (3) increase with increasing network size.

Investigation of the point representativeness of single measurements of radiactive rainout in a 15-storm sample indicated that an average error of 20 to 25 percent was introduced when a single observation was assumed to represent the mean rainout over areas of 10 to 12 square miles. Correlation analyses indicated that the rainfall at a given point was not strongly related to the radioactive rainout at that point. However, when areal patterns of rainfall and rainout were compared and allowance was made for displacement of high and low centers due to various meteorological influences, a strong association was indicated between the major features of the patterns in most storms.

Ill. State Water Survey, Urbana, Ill. 61803

332. Legrand, H. E. PATTERNS OF CONTAMINATED ZONES OF WATER IN THE GROUND. Water Resources Res. 1(1): 83-95. 1965.

Movement of contaminants from many waste sites into the subsurface water circulation system results in contaminated zones, or enclaves, in the zone of saturation (below the water table). Difficulty in predicting the areal extent of a contaminated zone stems from the multiplicity of factors that need consideration, including: The great variety of waste materials, their range in toxicity and adverse effects; man's variable pattern of waste disposal and of accidental release of contaminants in the ground; man's variable pattern of

water development from wells; behavior of each contaminant in the soil, water, and rock environment; ranges in geologic and hydrologic conditions in space; and ranges in hydrologic conditions in time.

Two opposing tendencies need to be in focus before an evaluation of contaminated zones is undertaken: (1) The tendency of contaminants to be entrained in groundwater flow; and (2) the tendency for contaminants to be attenuated to varying degrees by dilution in water, decay with time, and sorption on earth materials.

Once a contaminated zone is approximately stable, an increase in concentration may cause it to remain about the same size under some conditions and to enlarge under others, according to combined attenuation effects. Where attenuation occurs only by dilution, the contaminated zone will become enlarged with increased concentration, and, where dilution is also slight, it may become greatly elongated in the direction of groundwater, and perhaps also of surface-water flow. Where attenuation occurs also through decay or sorption, or through both mechanisms, the contaminated zone may not enlarge appreciably, even if the concentration of contamination is increased.

U.S. Geol. Survey, Washington, D.C. 20240

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